

**CTD, XBT, and XSV Data from the Greenland Sea:
R/V *Knorr* Cruise 8809 (6 September – 4 October 1988) and
R/V *Endeavor* Cruise EN200 (3 August – 10 September 1989)
*Department of State Cruises 88-18 and 88-120***

by C.M. Bader, B.M. Howe, and J.A. Mercer
Applied Physics Laboratory, University of Washington

P.F. Worcester, B.D. Cornuelle, and P.J. Sutton
Scripps Institution of Oceanography

J. Lynch
Woods Hole Oceanographic Institution

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Applied Physics Laboratory University of Washington
1013 NE 40th Street Seattle, Washington 98105-6698

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ABSTRACT

Profile data from two cruises in the Greenland Sea are presented. During the first cruise in September - October 1988, there were 6 deep CTD stations occupied and 161 shallow CTD, XBT, and XSV drops made. During the second cruise in August - September 1989, there were 6 deep CTD stations occupied and 299 shallow CTD, XBT, and XSV drops made.

1. INTRODUCTION

The profile data presented in this report were taken in support of two projects. The goals of the first, the Greenland Sea Project (GSP) tomography experiment, were (1) to study the processes that occur during convection and ventilation of the deep waters in the Greenland Sea, and (2) to study the dynamics of the wind-driven Greenland Sea gyre. The goals of the Moving Ship Tomography (MST) project are (1) to determine the precision with which the ocean mesoscale sound speed field can be measured by moving ship tomography, and (2) to study mesoscale eddy kinematics and dynamics. The MST project made use of the acoustic sources installed for GSP to perform engineering tests.

The acoustic moorings were installed (Figure 1.1), and deep CTD stations were occupied during the first part of the R/V *Knorr* cruise in September 1988. During the last eight days of the cruise, MST tests were conducted (MST88). XBT and/or XSV measurements (760 m and 850 m, respectively) were made at approximately 13 km spacing along all but 3 of the 15 transmission paths between the transceiver moorings (Figure 1.2).

The MST89 cruise dates of 3–16 August 1989 encompassed Leg 1 of EN200. A CTD profile was taken to a depth of 135 m (the base of the deployed acoustic array) at each of the 54 acoustic stations. Five sections, from moorings 1–3, 1–4, 1–5, 3–4, and 3–5, were made with XBTs deployed every 6 km and an XSV deployed every 30 km (Figure 1.3). Six deep CTD stations were occupied during Leg 3, from 5 to 10 September.

2. INSTRUMENTATION

A Sea-Bird Electronics (SBE) Model 9-02 underwater CTD unit, serial number 91685, was used for both cruises. The underwater unit contained the following sensors: dual temperature sensors (model SBE-3-02/F, serial numbers 843, primary, and 844, secondary), dual conductivity sensors (model SBE-4-02/O, serial numbers 484, primary, and 485, secondary), and a submersible pump (model SBE-5-02, serial number 128). The pump increased the flushing speed of water through the conductivity sensors to improve their dynamic response. Two Paroscientific Digiquartz pressure sensors were used; shallow casts were made using a 0–3000 psi (0–2000 m) sensor (model SBE 12-03/T, serial number 33273), and deep casts were made using a 0–10,000 psi (0–6000 m) sensor (model SBE 12-02/T, serial number 26451). The CTD deck unit (model SBE 11, serial number 111685) was set to average 24 scans per second to produce one output scan per second. A personal computer was used both to control the deck unit and to acquire the data.

A General Oceanics rosette sampler with twelve 1.5-l Niskin bottles was used to collect water samples during the deep CTD casts. In 1988, the length of wire limited the maximum cast depth to about 2900 m.

XBT and XSV data were acquired using a Sippican Mark 9 system. The XBT probes were Sippican model T-7, 760 m, and the XSV probes were Sippican model XSV-02, 850 m.

For the purposes of these profile data, positions were obtained from LORAN-C instruments. For the 1988 cruise, data from the ship's Northstar 6000 were used. For the 1989 cruise, data from both the ship's Northstar 6000 and APL's Northstar 800 were used, the former substituting if the latter had a gap. For the second cruise, a simple filtering procedure was used to clean up the data (there were some lane jumps) before positions were assigned to the XBT and XSV profiles based on time (personal communication, B. Cornuelle and P. Sutton). These positions are expected to be accurate to within 1 km.

3. CALIBRATION AND DATA PROCESSING

Calibrations of the CTD sensors were performed on four different occasions. SBE calibrated all sensors at the Northwest Calibration Center (NWCC) in April 1988 and December 1990. Scripps Technical Services at SIO calibrated them in February 1989 and in June 1990. The deep CTD data reported here for 1988 and 1989 use the SIO calibrations of 1989 and 1990, respectively. The shallow CTD data from both 1988 and 1989 use the SIO calibration of February 1989. The differences are discussed below.

No attempt has been made to correct for the response of the temperature and conductivity sensors; indeed, no correction is possible since the data were averaged once per second in the deck unit. The sound speed algorithm of Del Grosso has been used to convert temperature, salinity, and depth (pressure) to sound speed.

There has been very little editing of the profiles reported here. The surface value has been set equal to the value at 5 m for the XBT and XSV profiles. Some XBT and XSV profiles have been thrown out because of obvious failure of the probe. The standard Sippican equations in Sippican software were used to convert raw data to engineering units. The deep CTD data for both years were gridded to 2-m intervals; the shallow CTD data were gridded to 1-m intervals. The XBT and XSV data were gridded to standard depths: 0, 5, 10, ...50, 60, 70, ...200, 220, 240 ...740, ...800 m.

4. DISCUSSION OF RESULTS

Logs showing times and positions for the various profiles are presented in Appendices A and B for 1988 and 1989, respectively. Each profile is plotted in Appendices C and D. In this section, averaged and overlaid profiles are presented with a brief discussion.

All the data are available on cartridge tape (UNIX) and/or floppy disks (PCs), in addition to being available from the National Ocean Data Center (NODC).

4.1 1988 Data

CTD Data

In early September, a warm (5°C) surface layer was over the entire area; by the end of the cruise in early October, winter cooling had commenced.

Figure 4.1 shows the average of the six deep CTD profiles, and Figure 4.2 shows the individual casts plotted on top of each other so one can see the variability that is present. There is evidence of occasional salinity spiking. One profile appears anomalously warm and salty between the surface and 1000 m relative to the others. Figure 4.3 shows the T-S scatter plot from these data.

To see the possible effects of different calibrations, the differences (SBE April 1988 – SIO/ODF February 1989) between variables are plotted in Figures 4.4a and 4.4b for cast 001. Below about 40 m, the temperature difference is within 0.001°C while salinity, sound speed, and density (σ_θ) are within 0.01 ppt, 0.01 m/s, and 0.02 σ_θ units, respectively. Above 40 m, salinity spiking is much more pronounced.

Figure 4.5 shows the average of the 21 shallow CTD casts made as part of the deployment of the acoustic array for MST. It is clear that salinity for the most part controls the density. The negative density gradient at the surface is undoubtedly an artifact of the averaging and/or the sensitivity of density to (suspect) salinity measurements. Figures 4.6a–4.6d show the individual profiles. Within the mixed layer and down to 125 m,

there is about 2°C peak-to-peak variation in temperature and a 10 m/s variation in sound speed. Salinity varies about 1.5 ppt in the mixed layer (to 30 m) and about 0.1 ppt at 100 m. Density follows this trend, varying 1.5 σ_θ units in the mixed layer and 0.1 σ_θ units at 100 m.

XBT and XSV Data

Figure 4.7 shows the average temperature profile as obtained from the 118 drops shown in Figure 4.8. The values and variation are about the same as for the CTD data. There are some anomalously large temperatures at about 30 m depth. Figures 4.9 and 4.10 show similar data from the 24 XSV drops. The small peak in temperature and sound speed at ~30 m shows up in all the data and is consistent with the slight salinity minimum.

4.2 1989 Data

CTD Data

The deep CTD data from 1989 (Figures 4.11–4.13) look quite similar to the data from 1988. In one profile there appears to be a salinity-compensated warm feature between 100 m and 1000 m. There is somewhat less scatter in the T-S relation.

The shallow CTD data from 1989 show warmer water and a shallower mixed layer, not surprising since the 1989 data were taken in August while the 1988 data were taken in late September.

XBT and XSV Data

The XBT and XSV data for 1989 do not show the surface minimum and the subsurface maximum that were present in 1988.

5. BIBLIOGRAPHY

Howe, B.M., MST89: Moving Ship Tomography 1989 Experiment Summary (unpublished), 23 March 1989.

Munk, W., Greenland Sea Experiment 88 and Moving Ship Tomography 88: Shipboard Report, R/V *Knorr* (unpublished), October 1988.

Spindel, R.C., Moving Ship Tomography Test, Preliminary Shipboard Report (unpublished), 21 August 1989.

Worcester, P., GSP88: 1988 Greenland Sea Project Tomography Experiment Summary (unpublished), 4 December 1987.

Worcester, P., GSP88: Post-Experiment Summary (unpublished), 30 April 1990.

Worcester, P., and B. Howe, GSP88/MST88: Deployment Cruise Summary (unpublished), 1 February 1989.

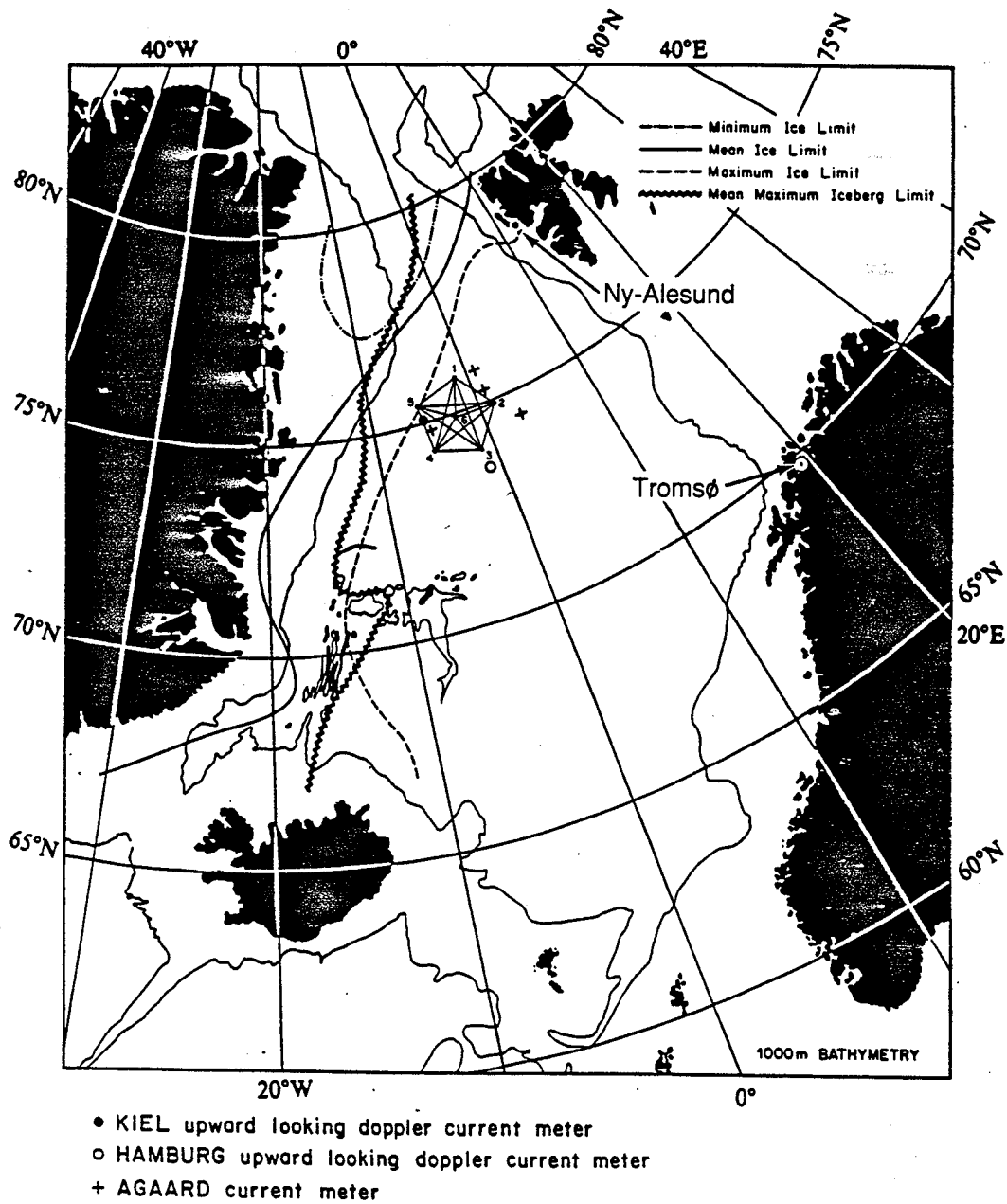


Figure 1.1. Six acoustic moorings are centered at 75°N, 003°W. Various related oceanographic installations are shown.

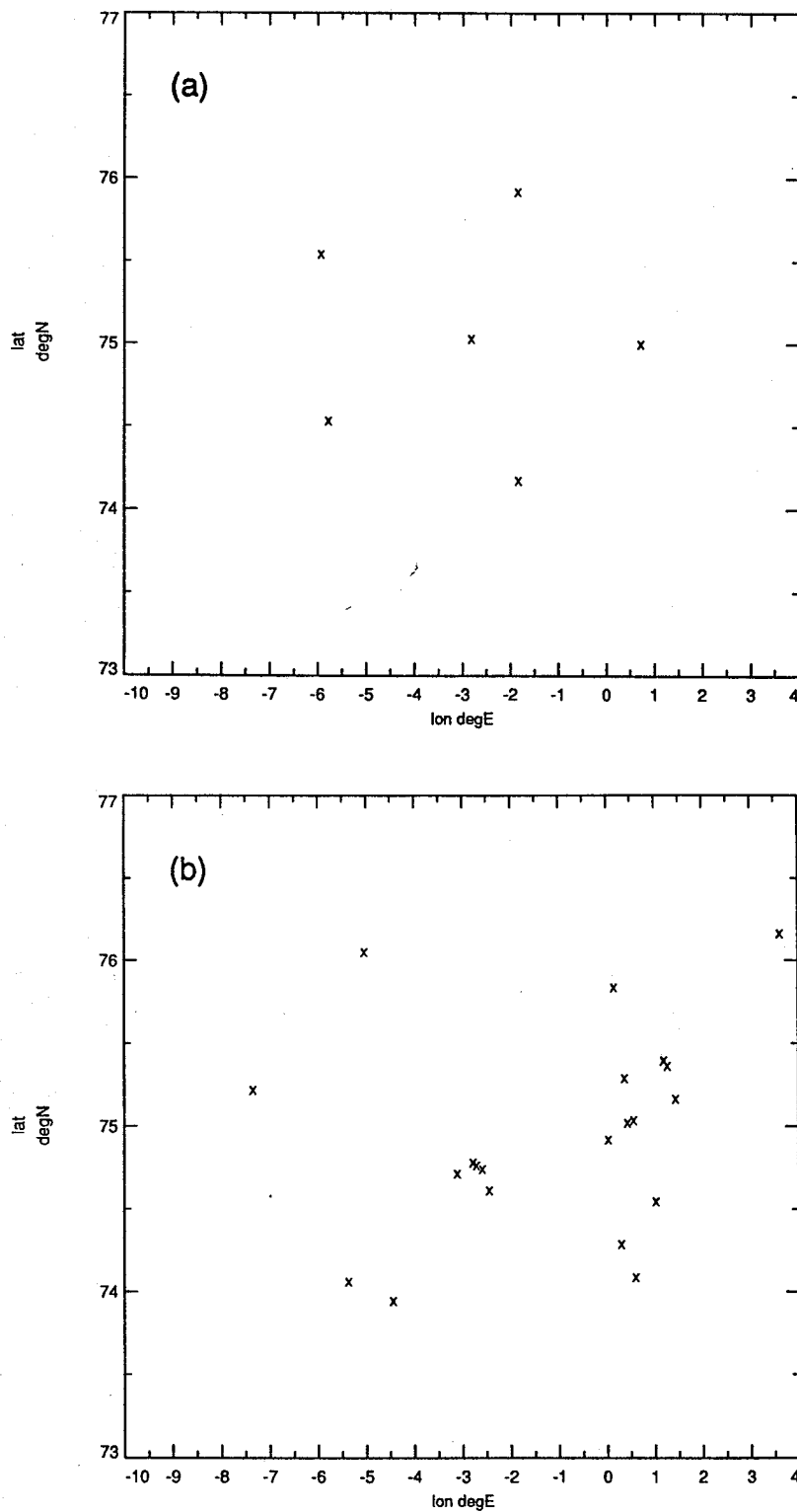


Figure 1.2. *Locations of (a) deep and (b) shallow CTD stations and (c) XBT and (d) XSV drops during the 1988 cruise. The tomography mooring locations correspond to the deep CTD stations.*

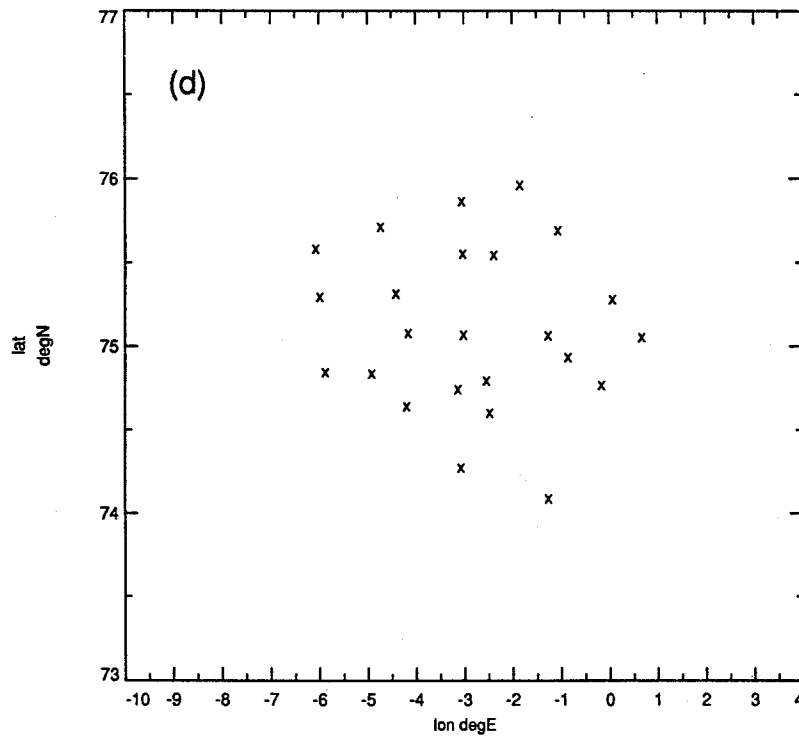
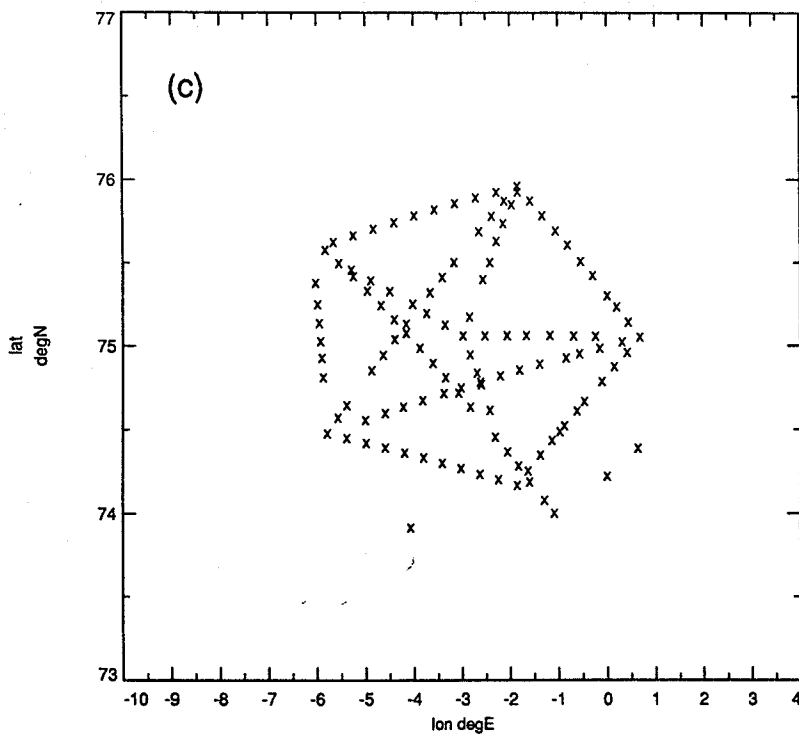


Figure 12, cont.

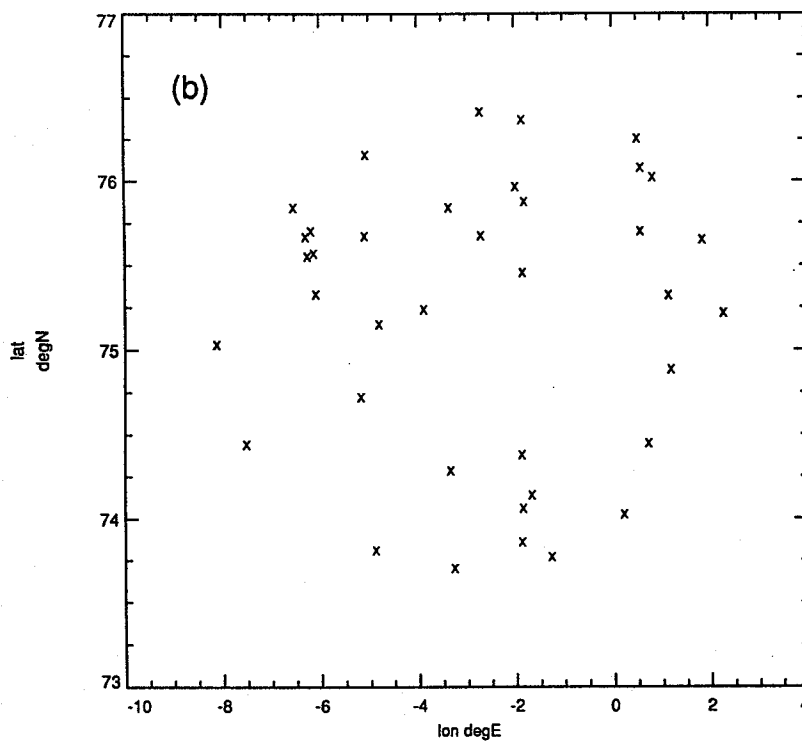
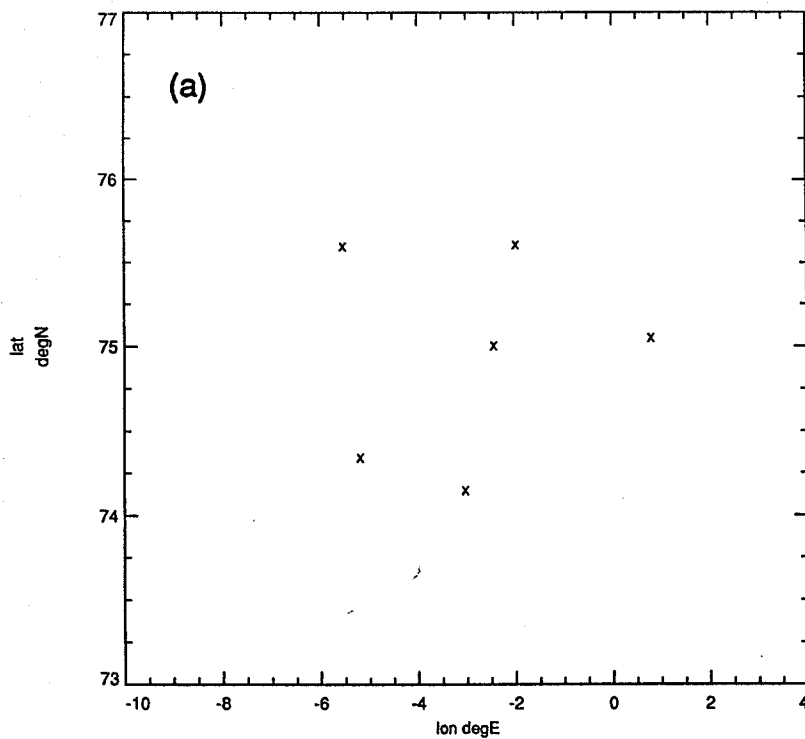


Figure 1.3. Locations of (a) deep and (b) shallow CTD stations and (c) XBT and (d) XSV drops during 1989 cruise.

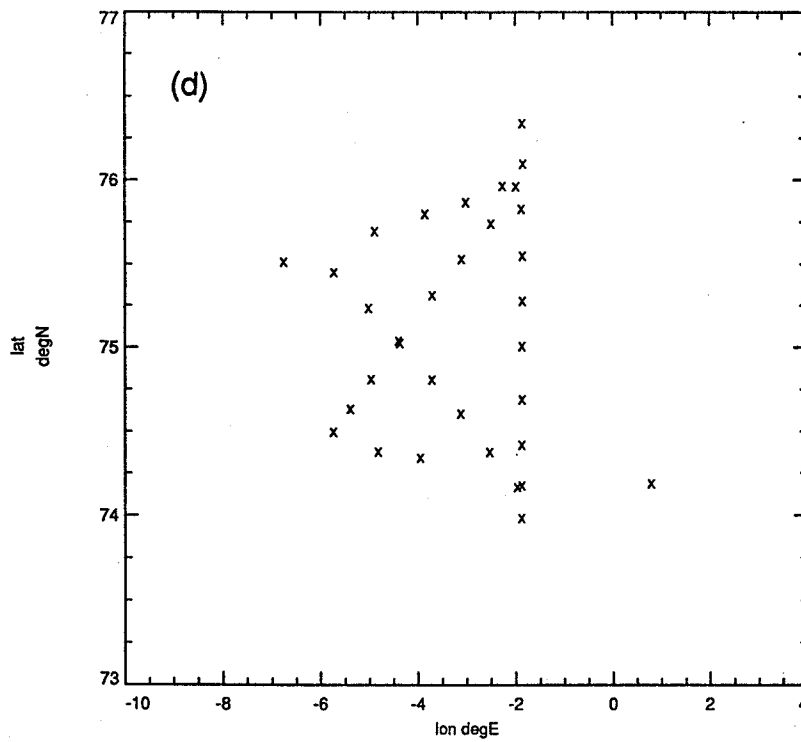
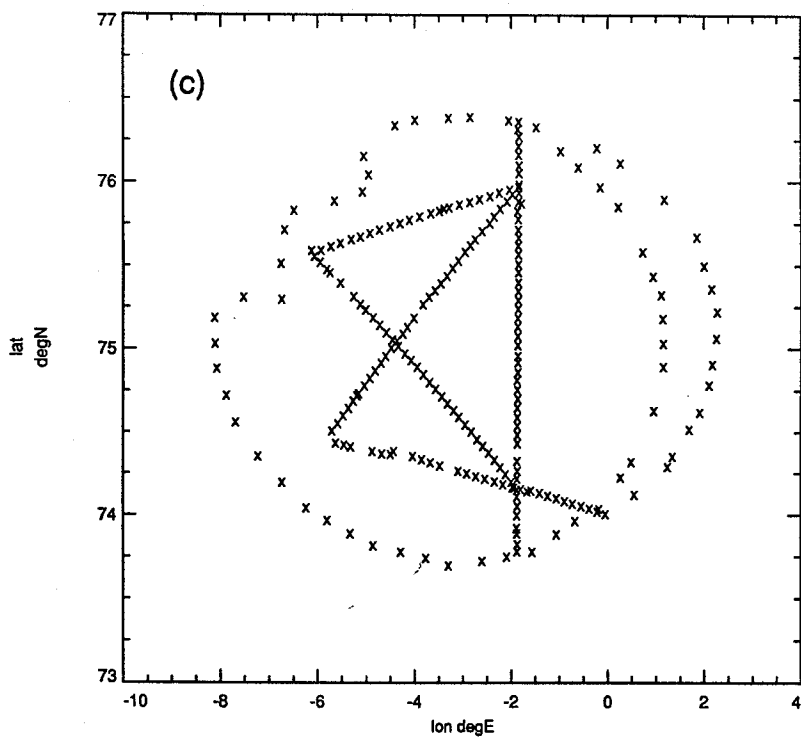


Figure 1.3, cont.

1988 MST : Average CTD

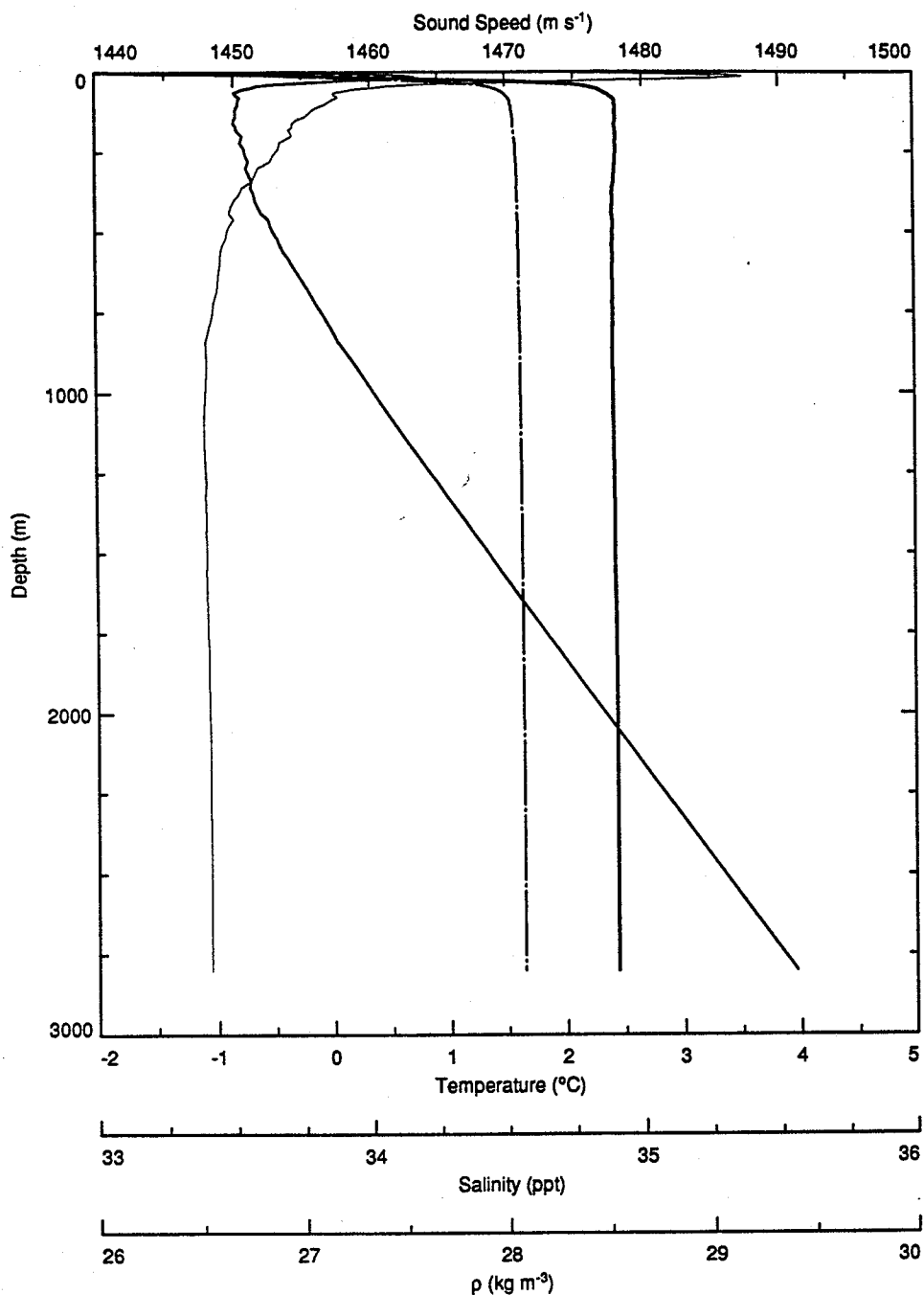


Figure 4.1. Average of all deep CTD profiles from the 1988 cruise. Key: temperature = thin line, salinity = heavy line, sound speed = medium line, and density (σ_{θ}) = dot-dash line.

CTD 88 - 6 Deep Casts - Temp

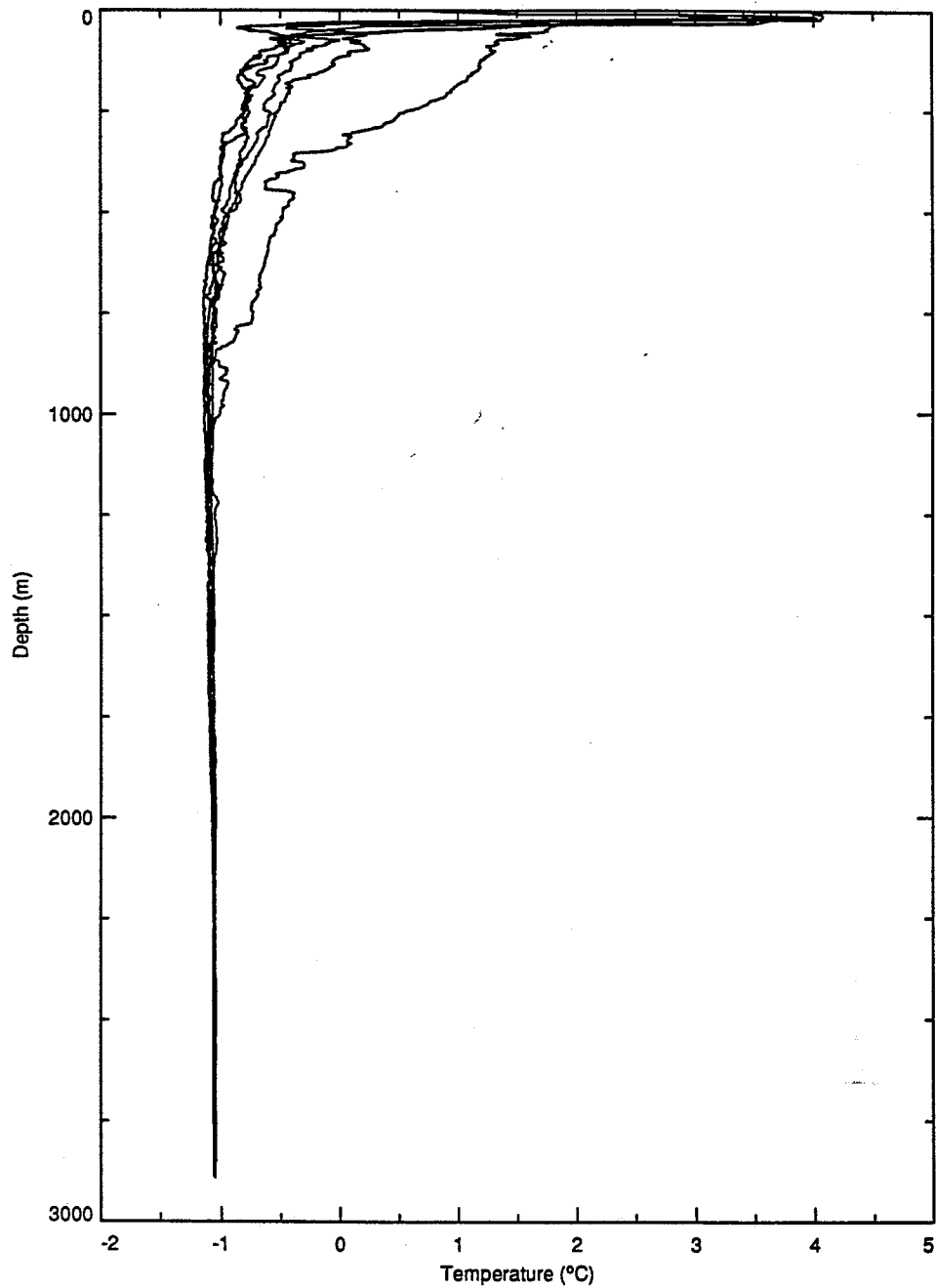


Figure 4.2. Deep CTD profiles from 1988. (a) temperature, (b) salinity, (c) sound speed, and (d) density.

CTD 88 - 6 Deep Casts - Salinity

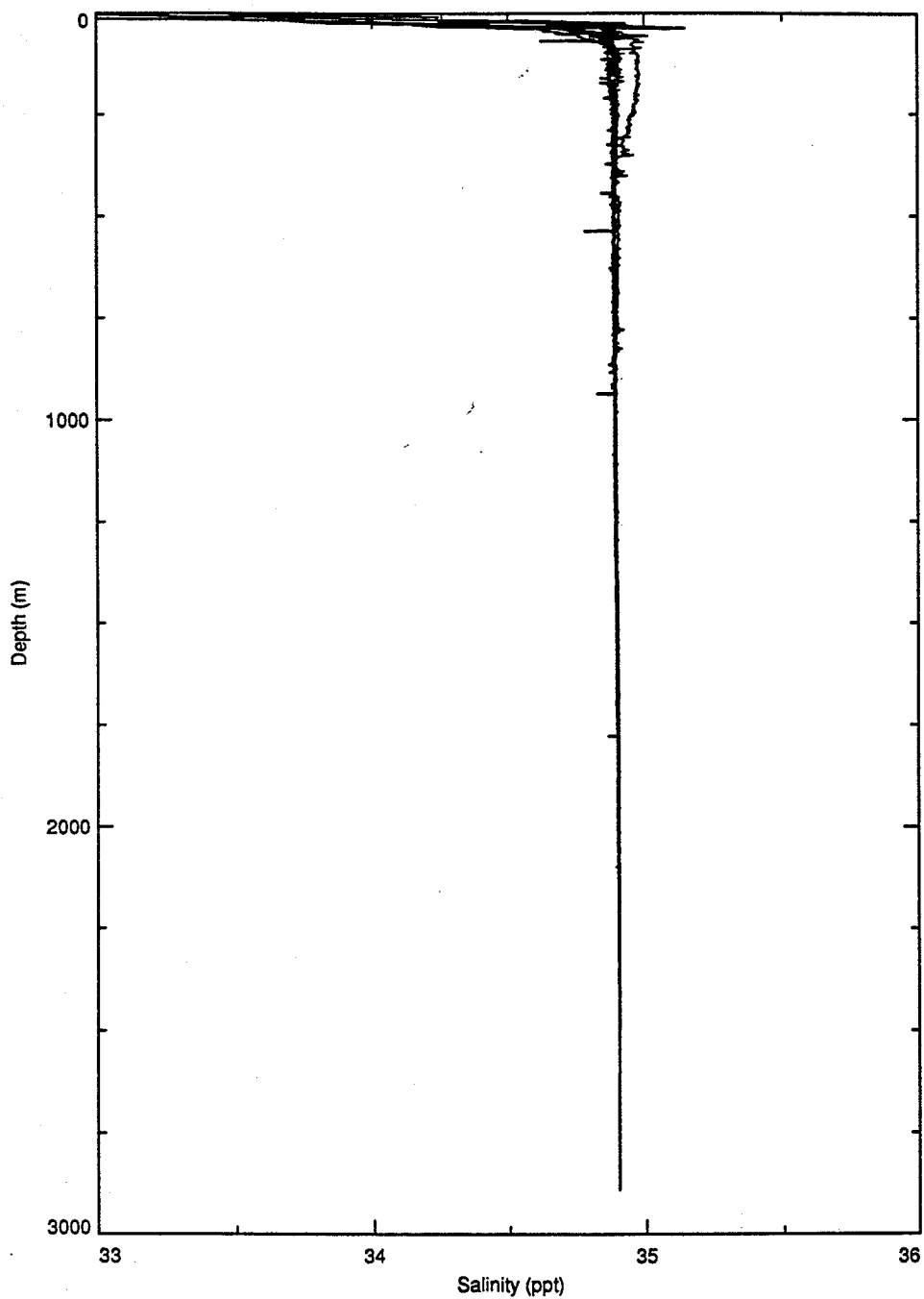


Figure 4.2, cont.

CTD 88 - 6 Deep Casts - Sound Speed

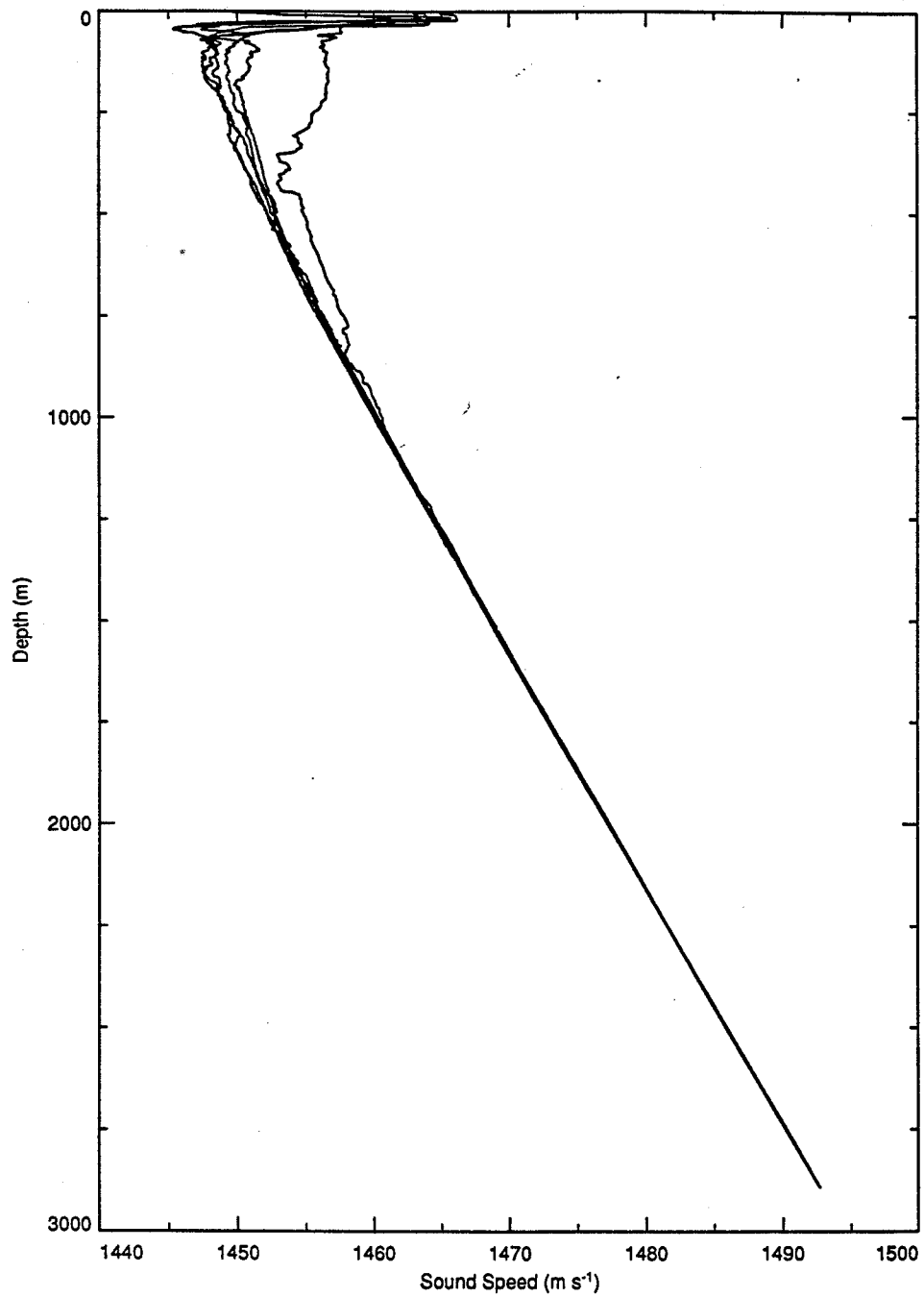


Figure 4.2, cont.

CTD 88 - 6 Deep Casts - Density

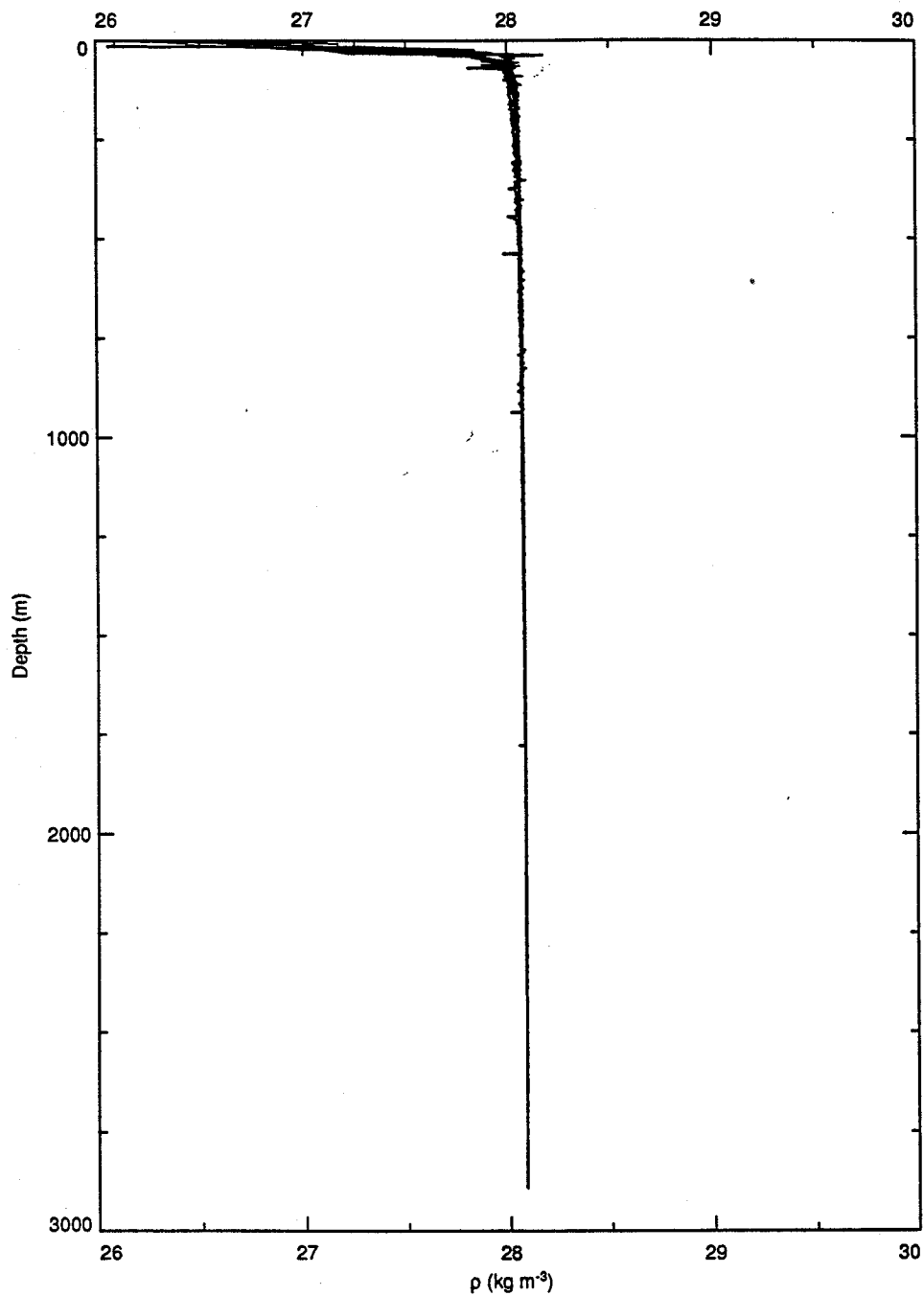


Figure 4.2, cont.

CTD 88 - 6 Deep Casts

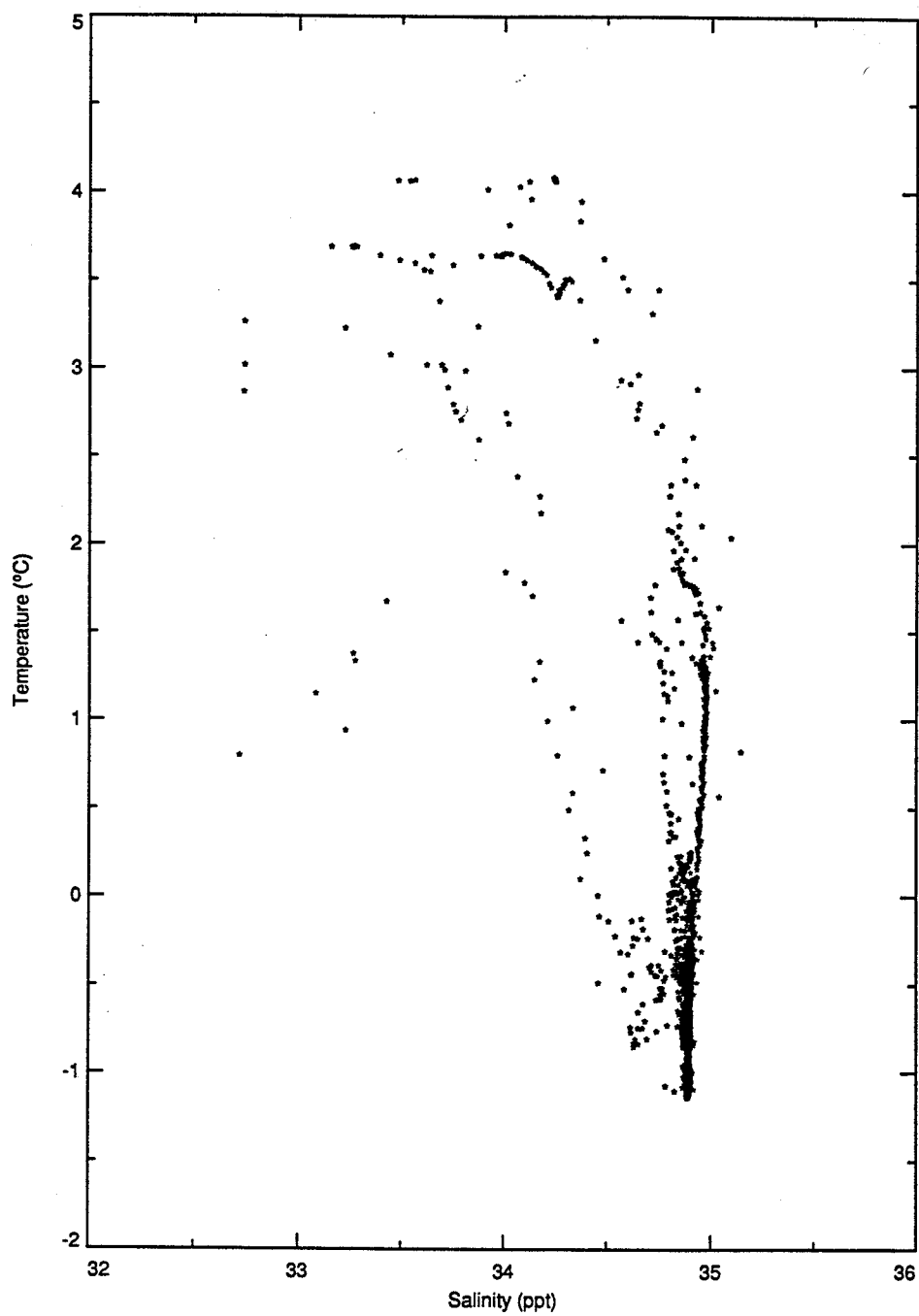


Figure 4.3. T-S relation based on deep CTD data from 1988.

1988 MST : SBE-SIO Cal

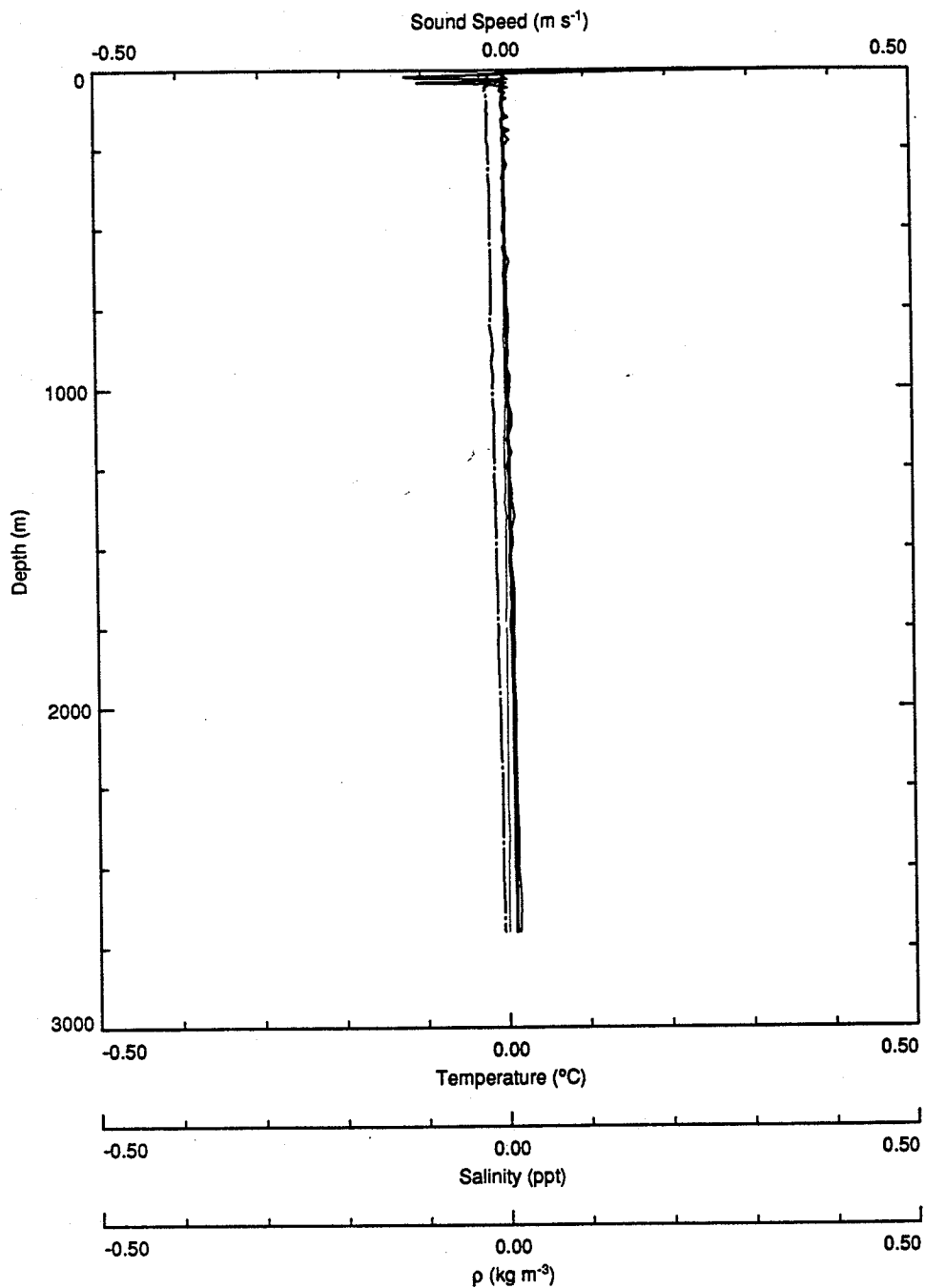


Figure 4.4a. Plot showing CTD(SBE calibration 16 April 1988) – CTD(SIO calibration 5 February 1989) for 1988, cast 1.

1988 MST : SBE-SIO Cal

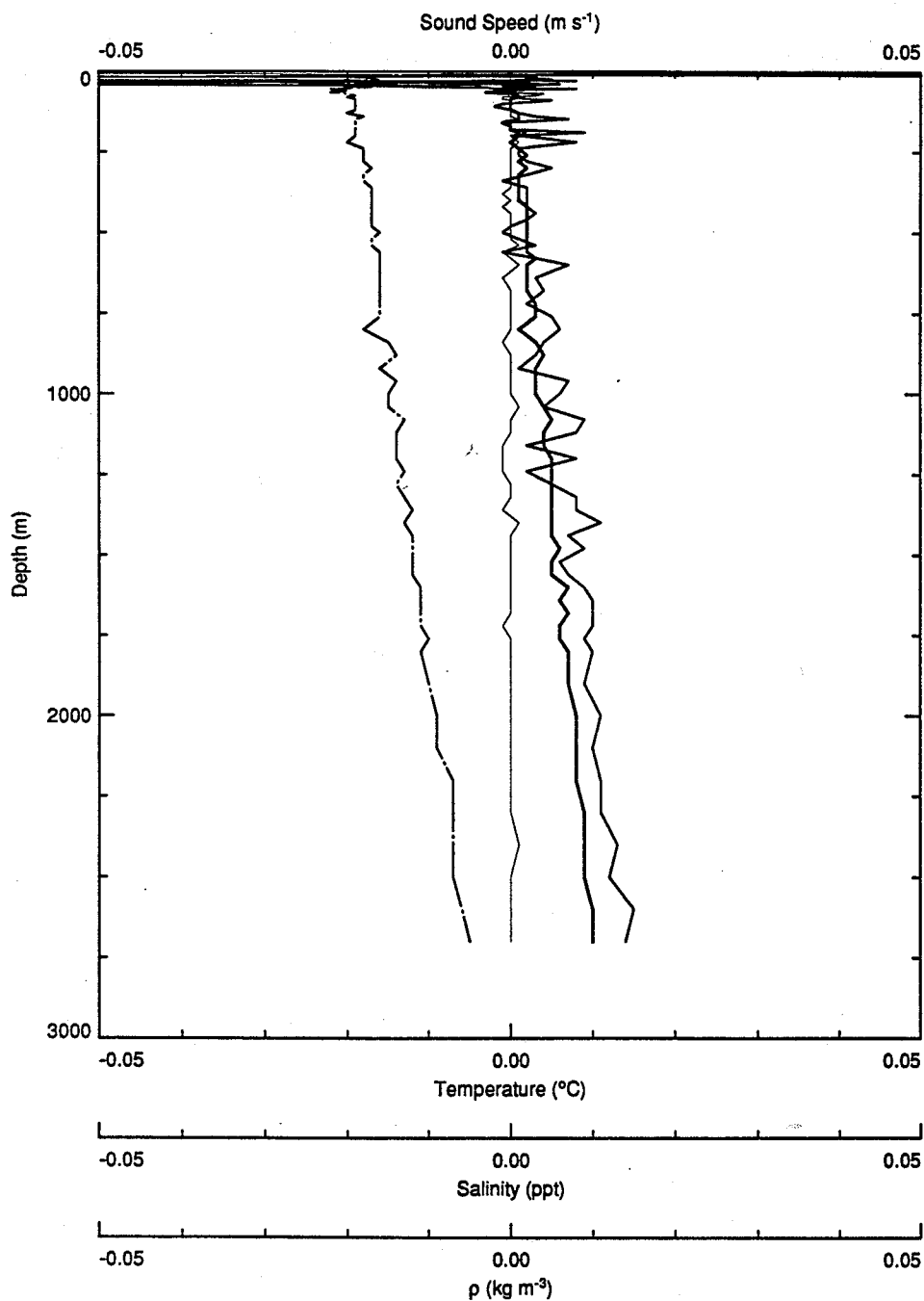


Figure 4.4b. Same as Figure 4.4a but with higher plotting resolution.

1988 MST : Average CTD

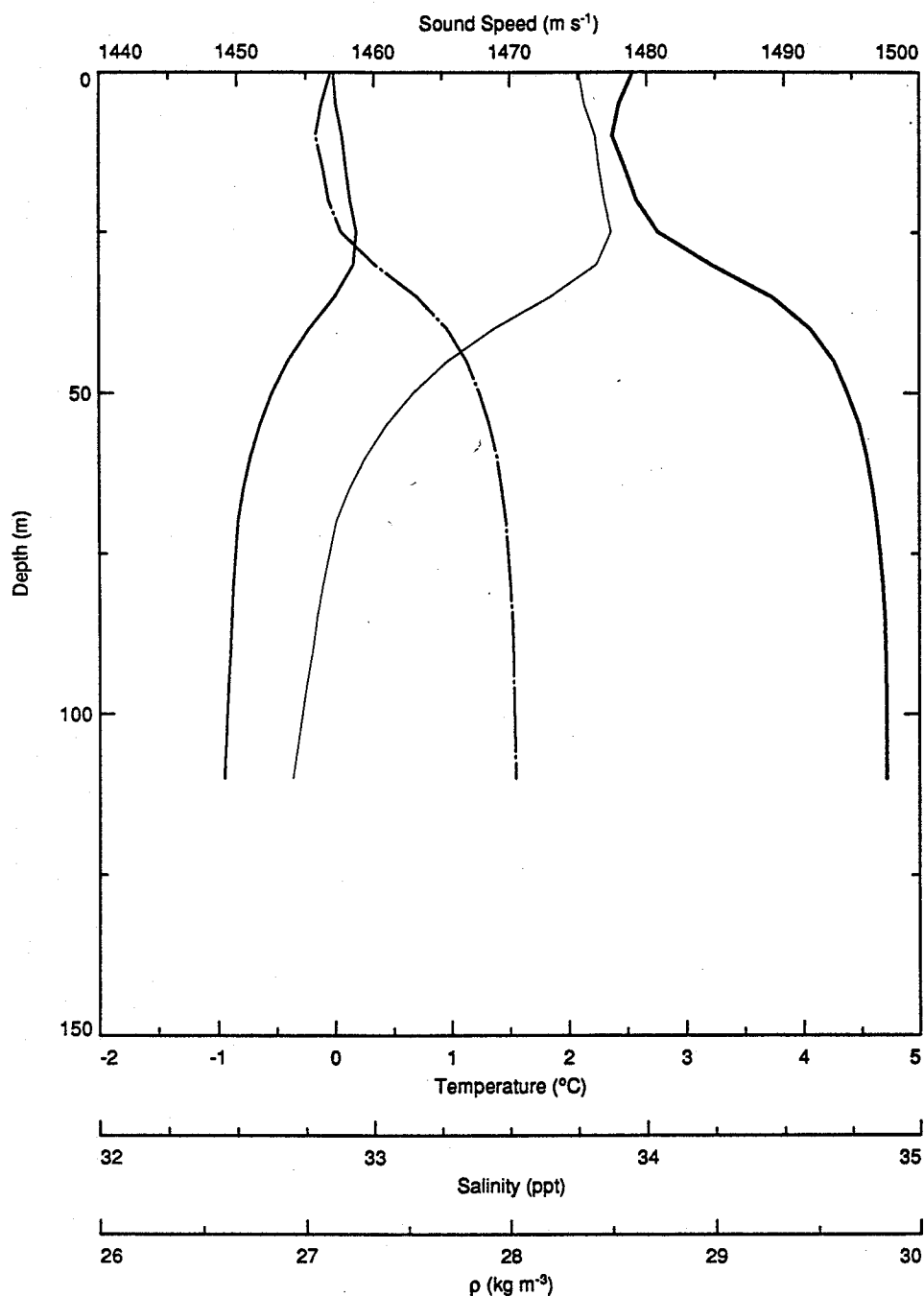


Figure 4.5. Average of all shallow CTD profiles from 1988. Key: temperature = thin line, salinity = heavy line, sound speed = medium line, and density (σ_{θ}) = dot-dash line.

MST 88 - Shallow Casts - Temp

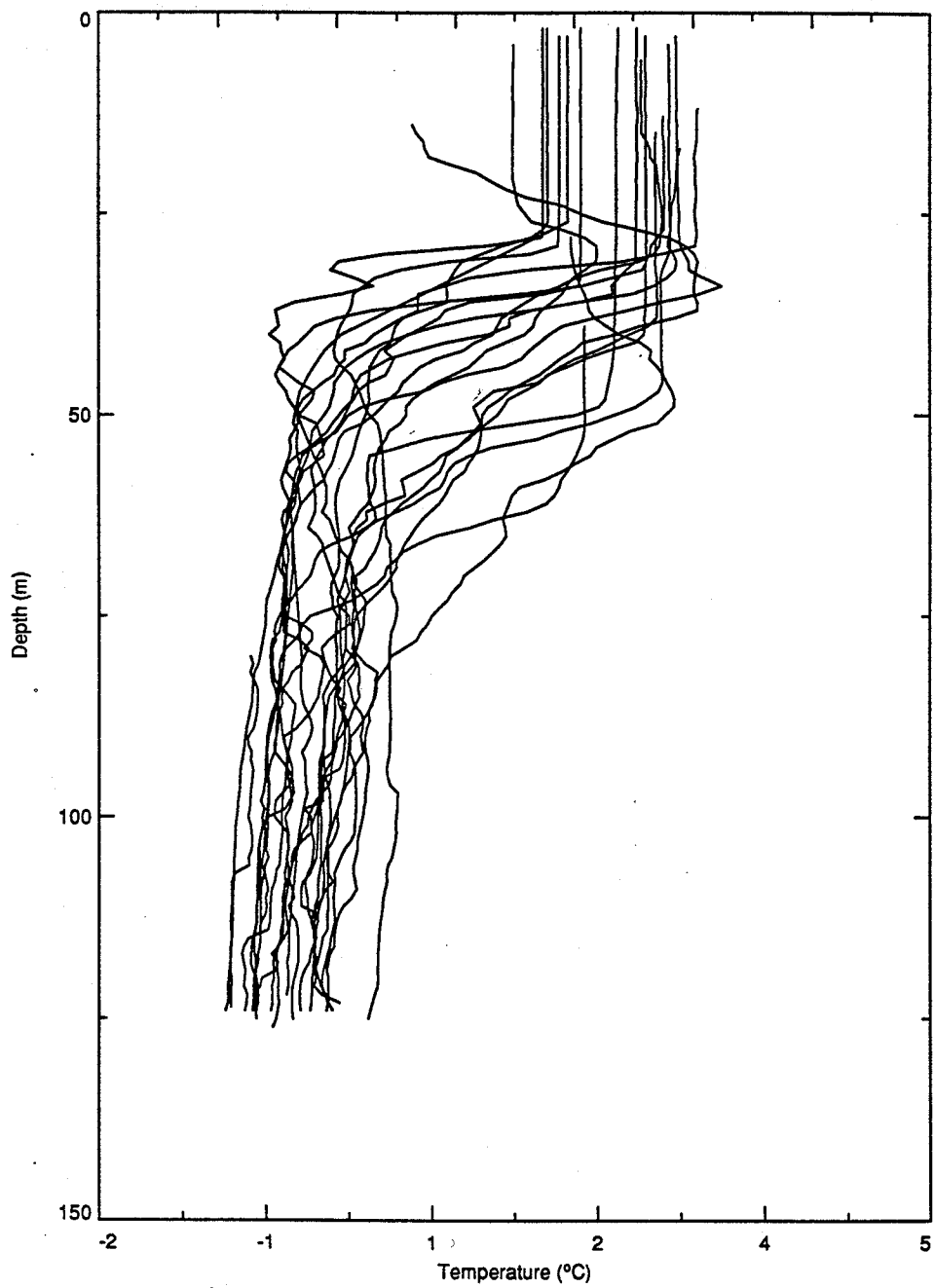


Figure 4.6a. Shallow CTD temperature profiles from 1988.

MST 88 - Shallow Casts - Salinity

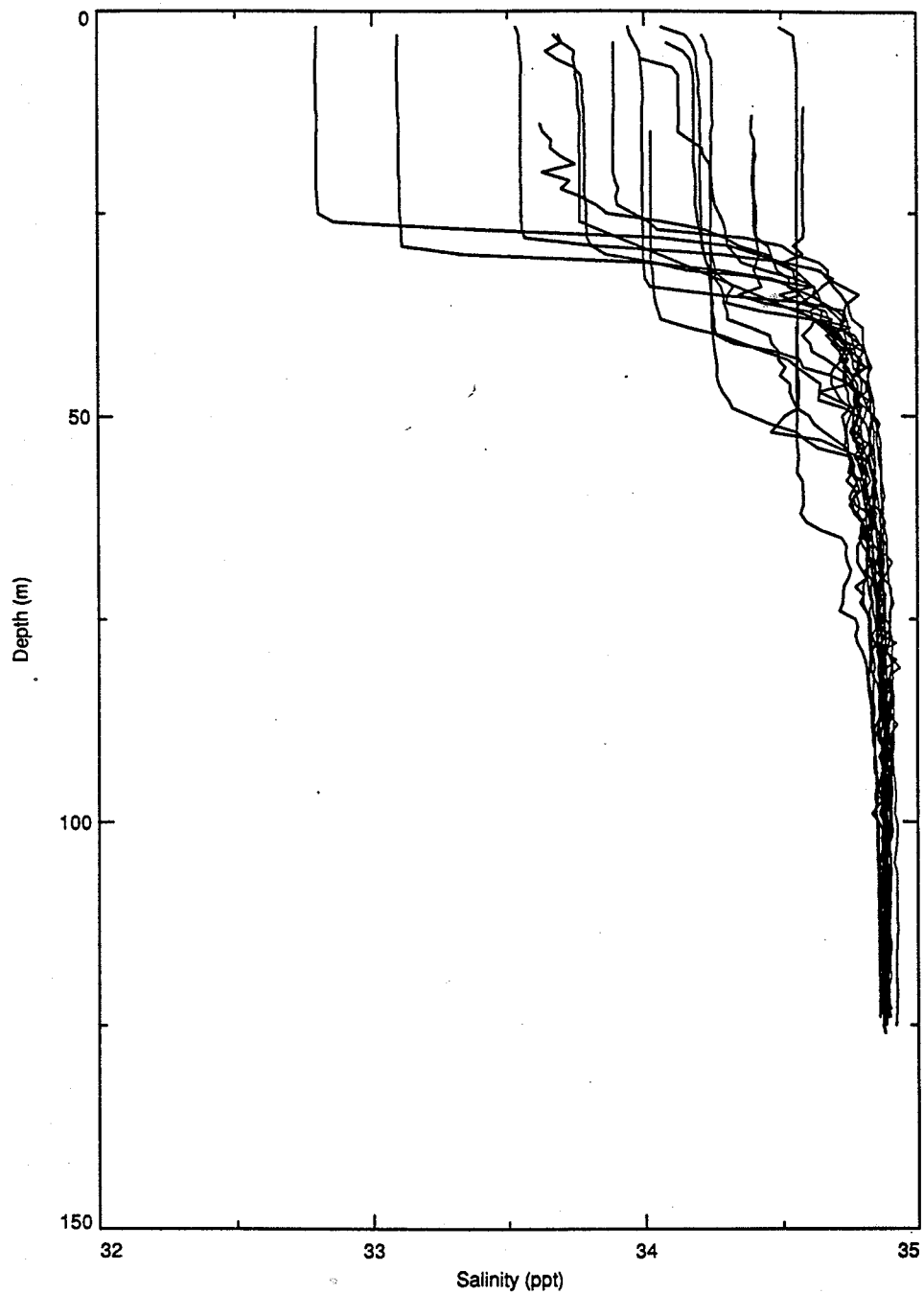


Figure 4.6b. Shallow CTD salinity profiles from 1988.

MST 88 - Shallow Casts - Sound Speed

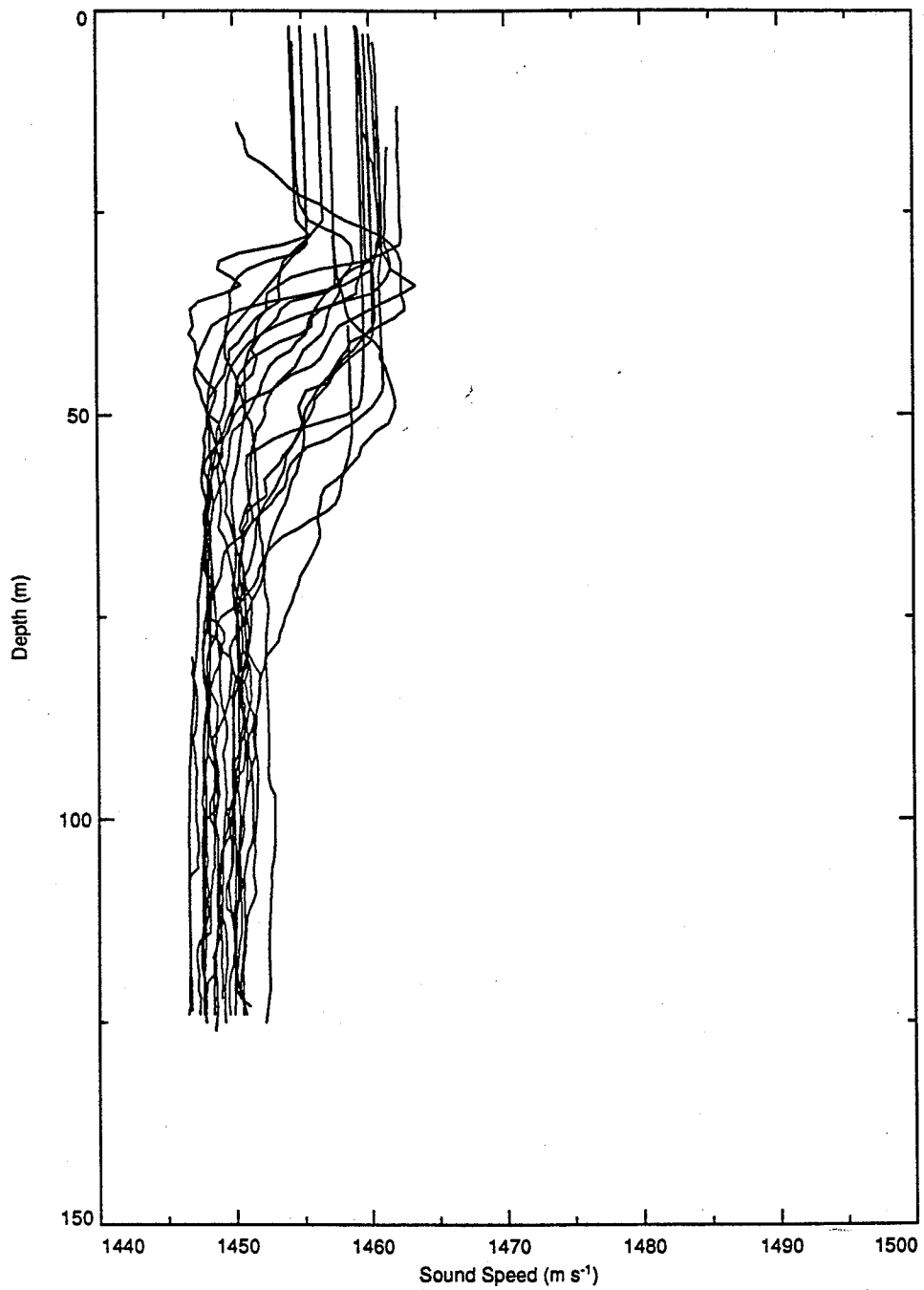


Figure 4.6c. Shallow CTD sound speed profiles from 1988.

MST 88 - Shallow Casts - Density

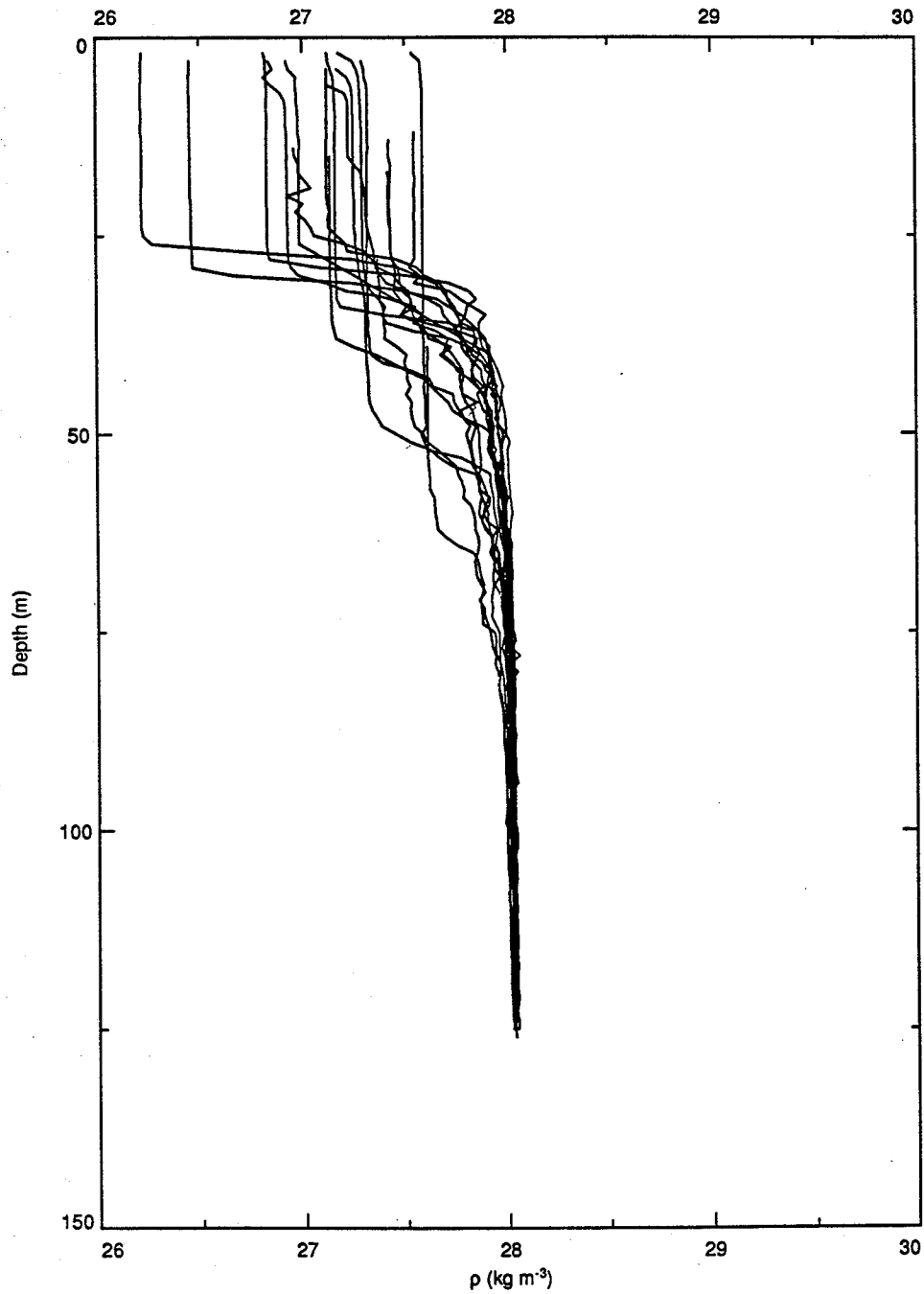


Figure 4.6d. Shallow CTD density profiles from 1988.

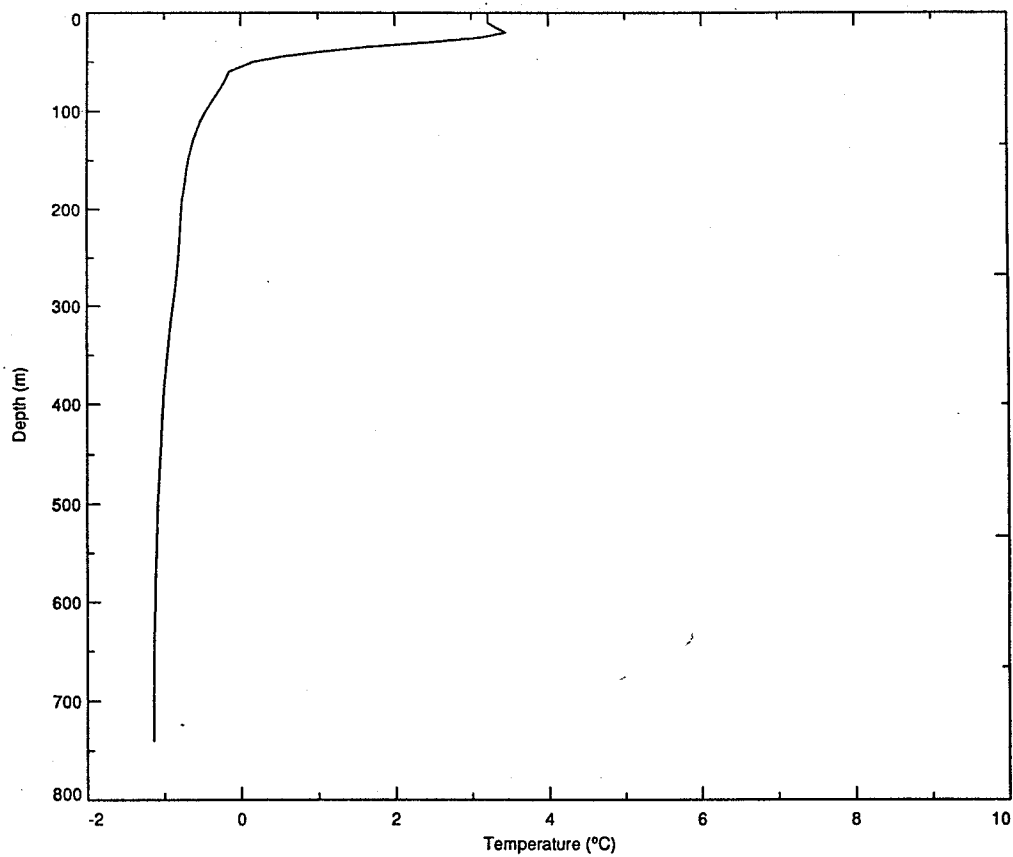


Figure 4.7.
Average of all XBT
profiles from 1988.

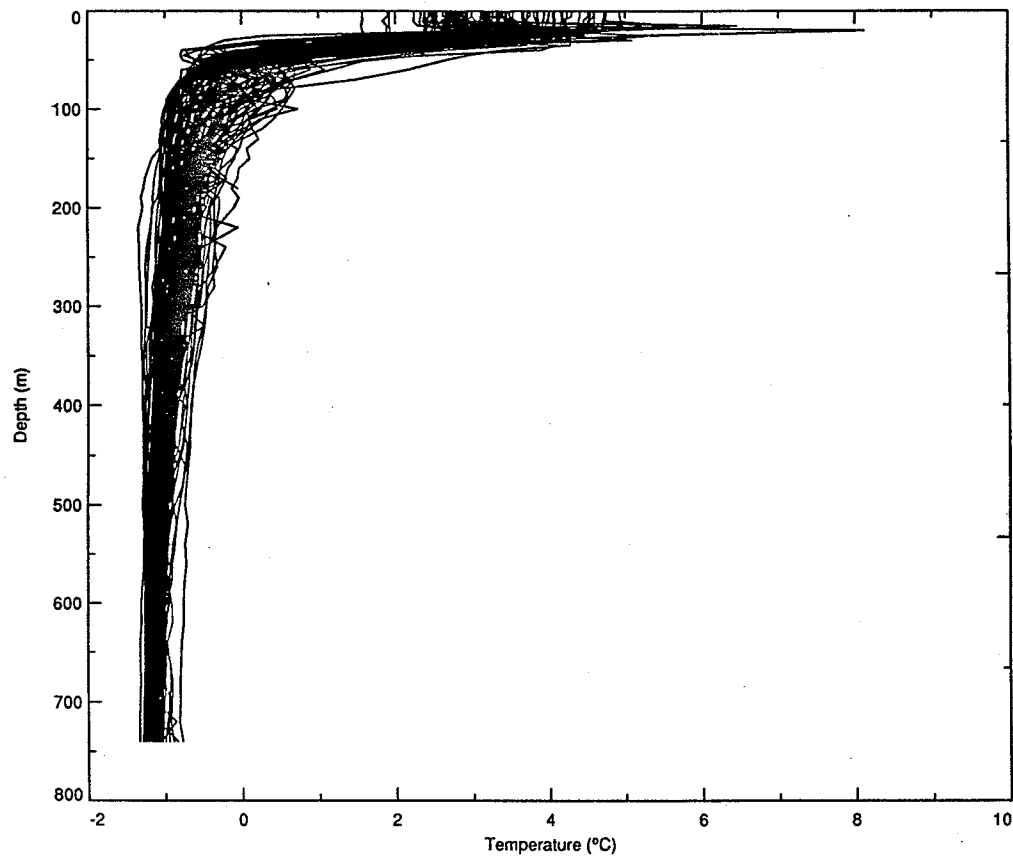


Figure 4.8.
XBT temperature profiles
from 1988.

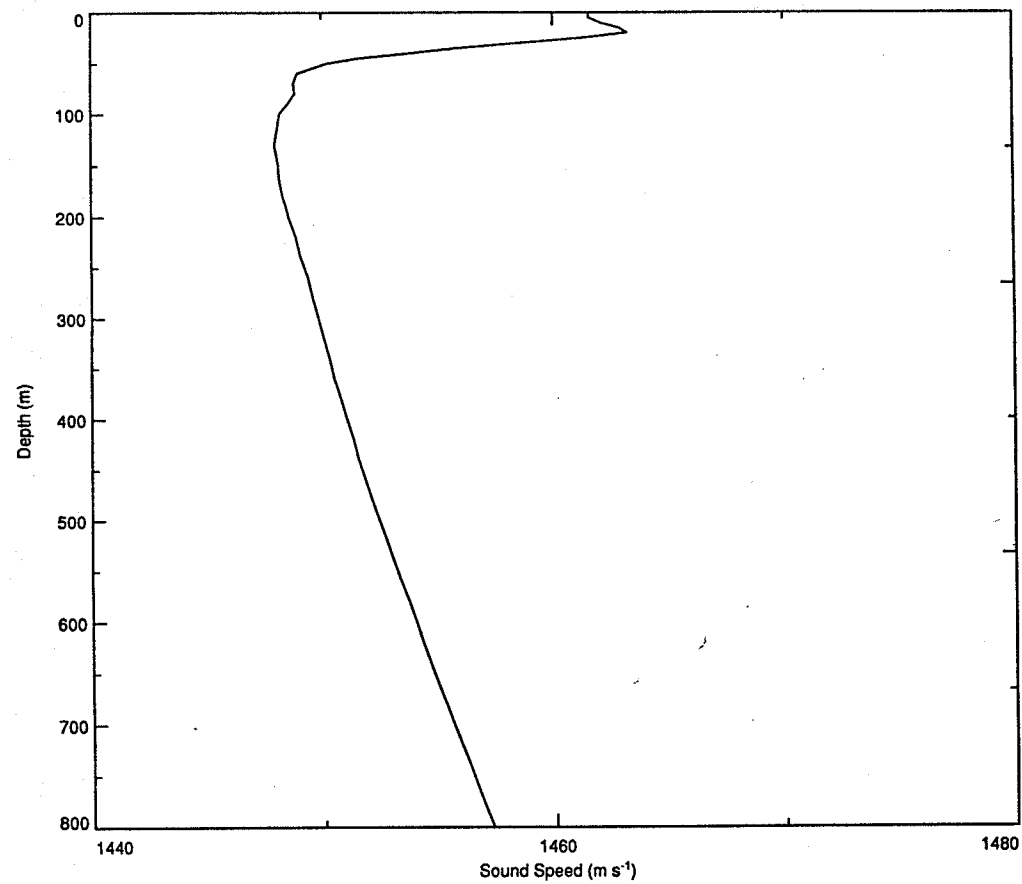


Figure 4.9.
Average of all XSV
profiles from 1988.

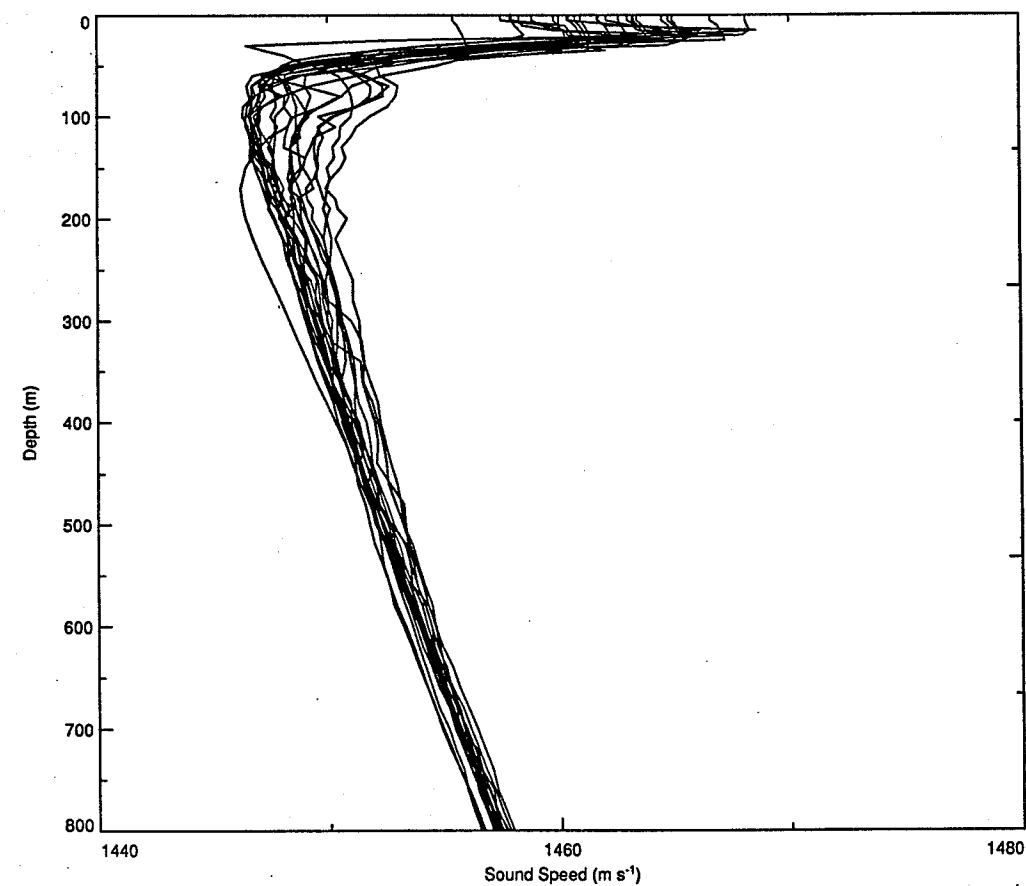


Figure 4.10.
XSV sound speed profiles
from 1988.

1989 MST : Average CTD

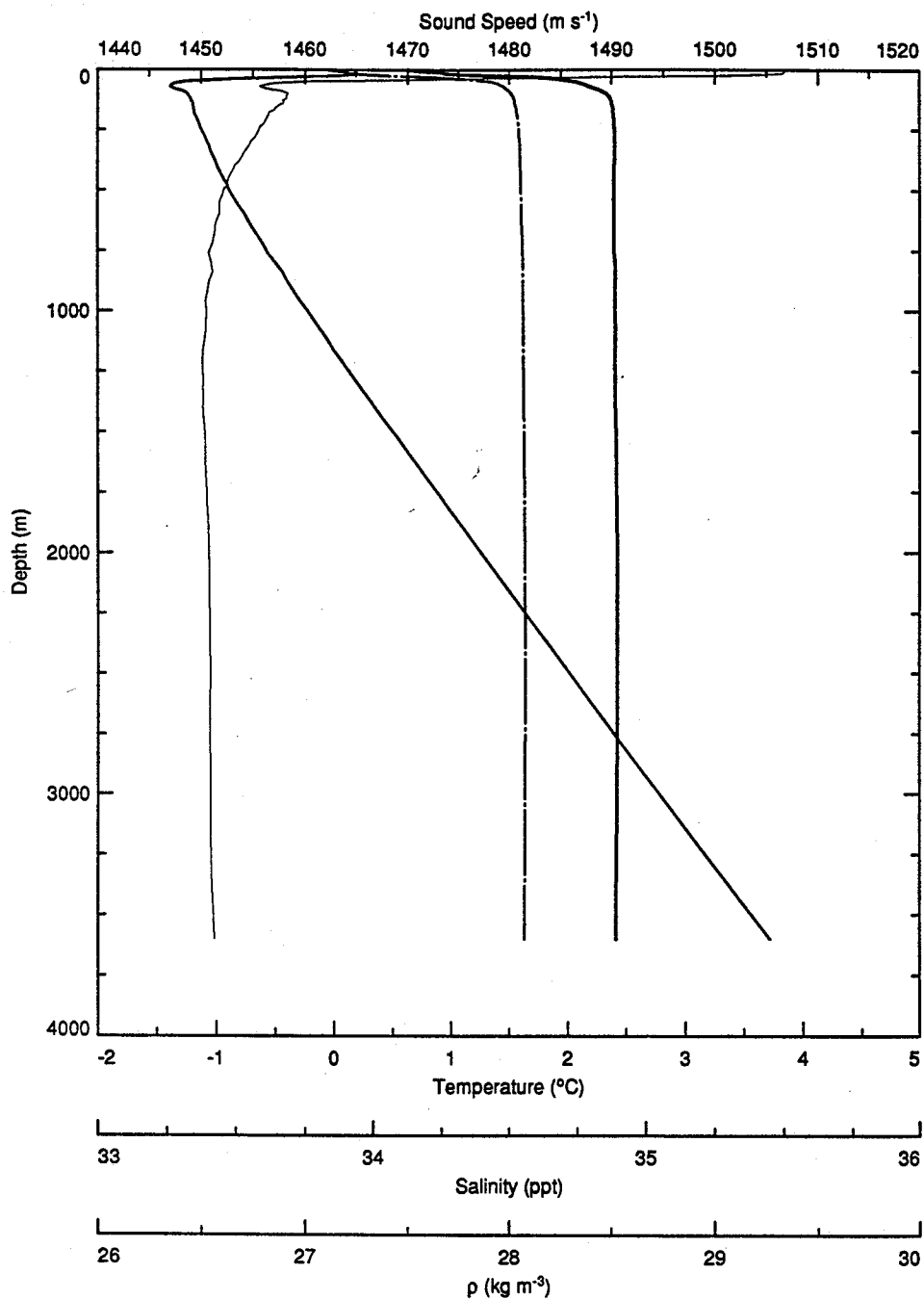


Figure 4.11. Average of all deep CTD profiles from 1989.

GSP 89 - 6 Deep Casts - Temp

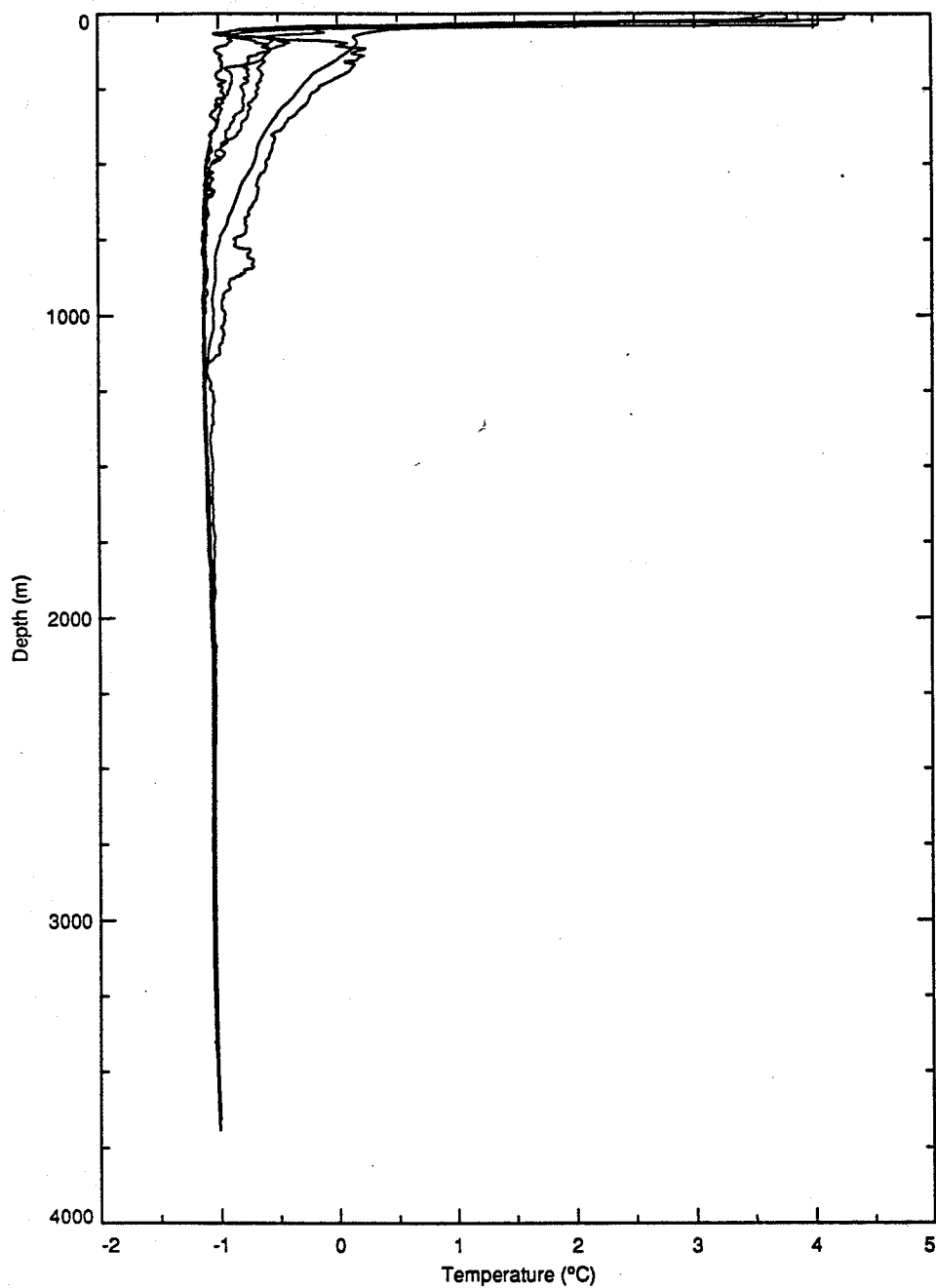


Figure 4.12a. Deep CTD temperature profiles from 1989.

GSP 89 - 6 Deep Casts - Salinity

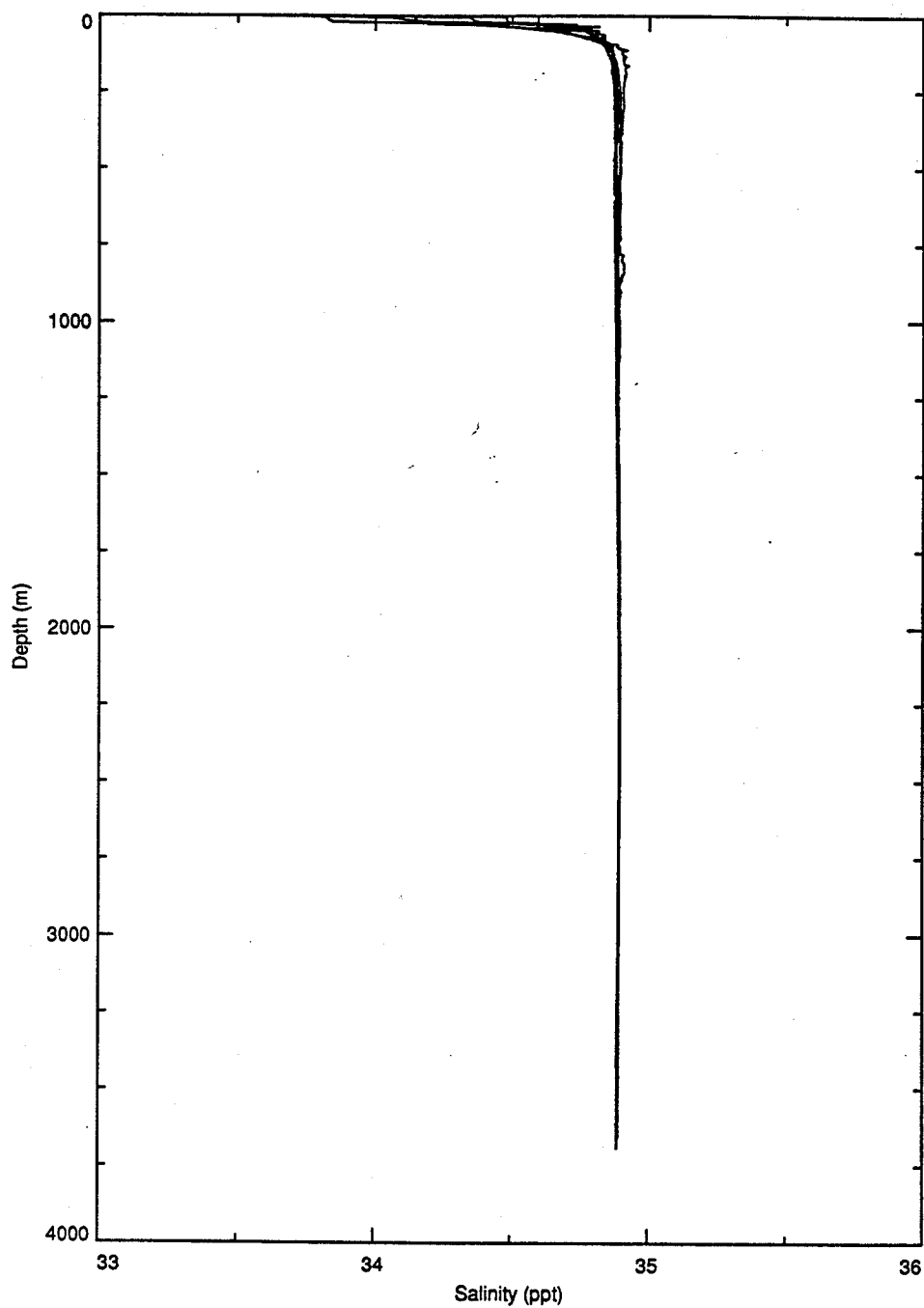


Figure 4.12b. Deep CTD salinity profiles from 1989.

GSP 89 - 6 Deep Casts - Sound Speed

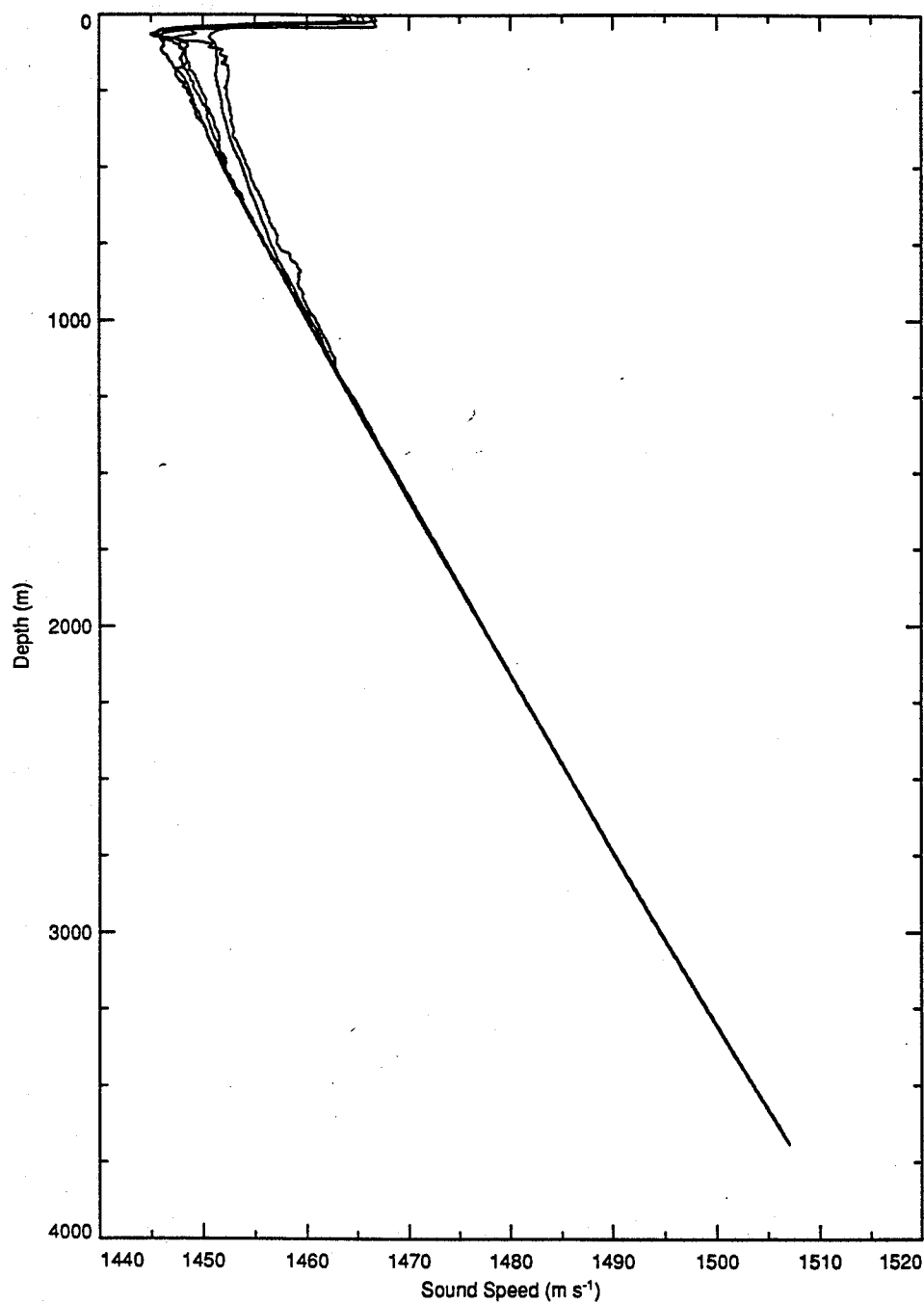


Figure 4.12c. Deep CTD sound speed profiles from 1989.

GSP 89 - 6 Deep Casts - Density

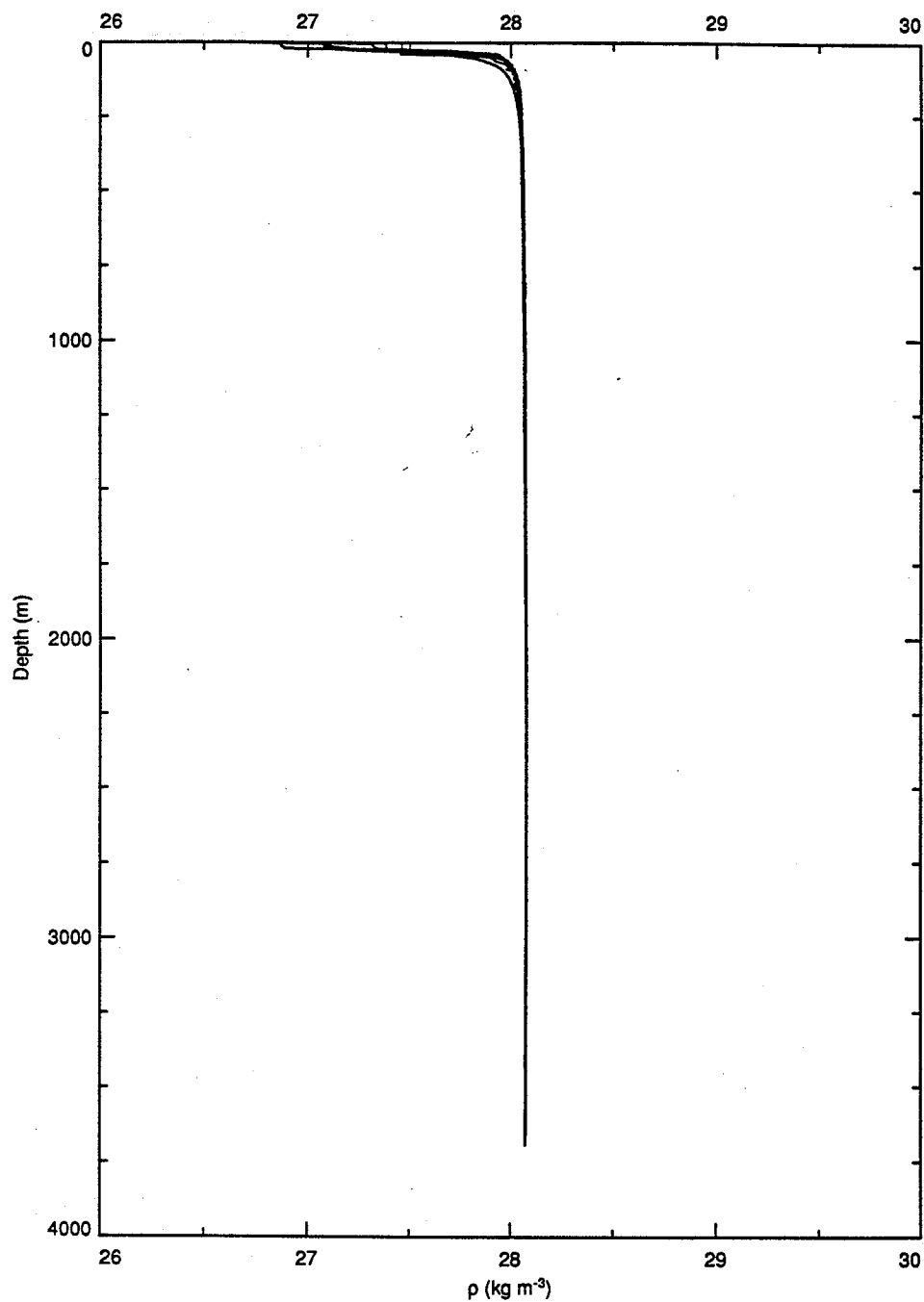


Figure 4.12d. Deep CTD density profiles from 1989.

CTD 89 - 6 Deep Casts

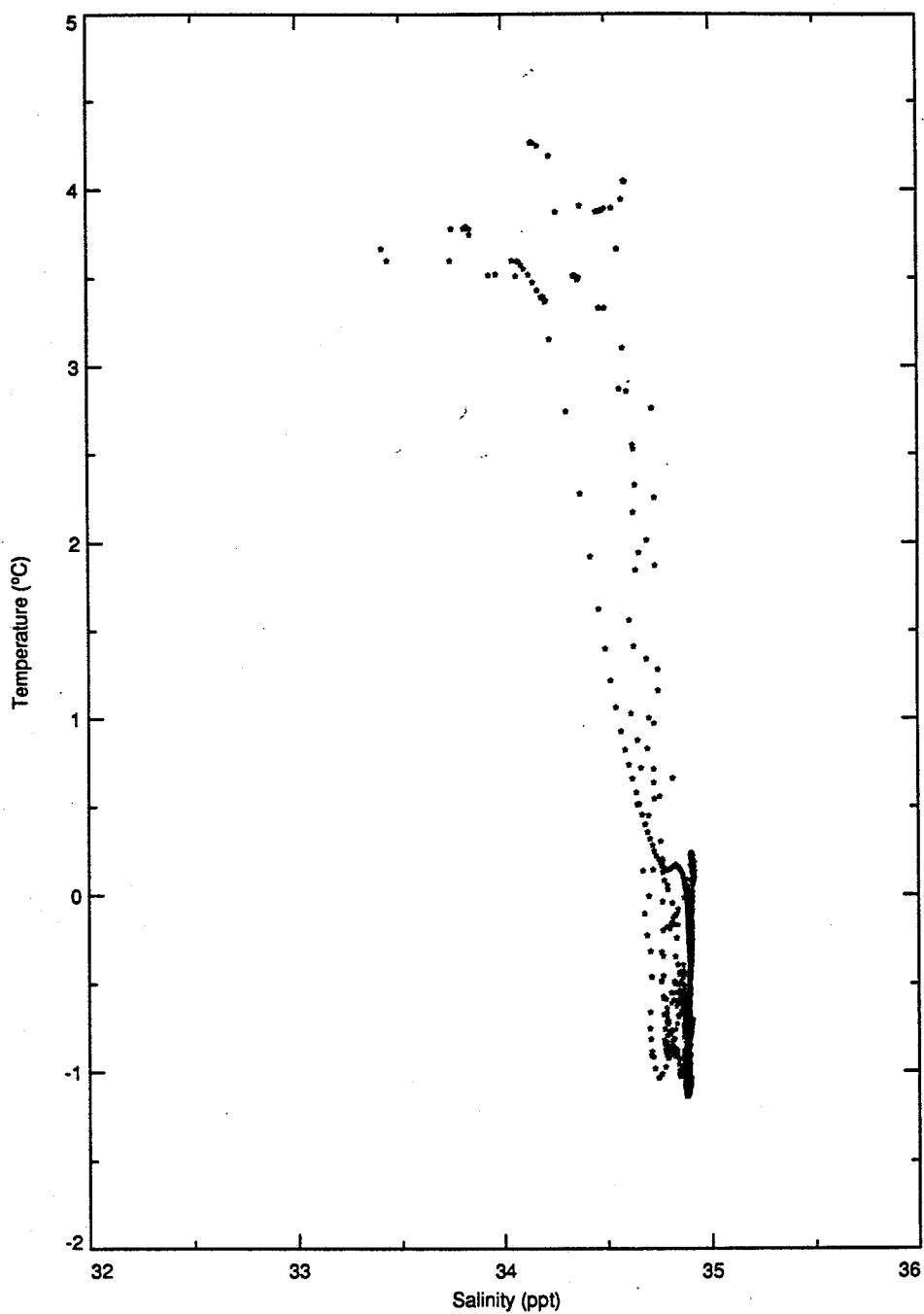


Figure 4.13. *T-S relation based on deep CTD data from 1989.*

1989 MST : Average CTD

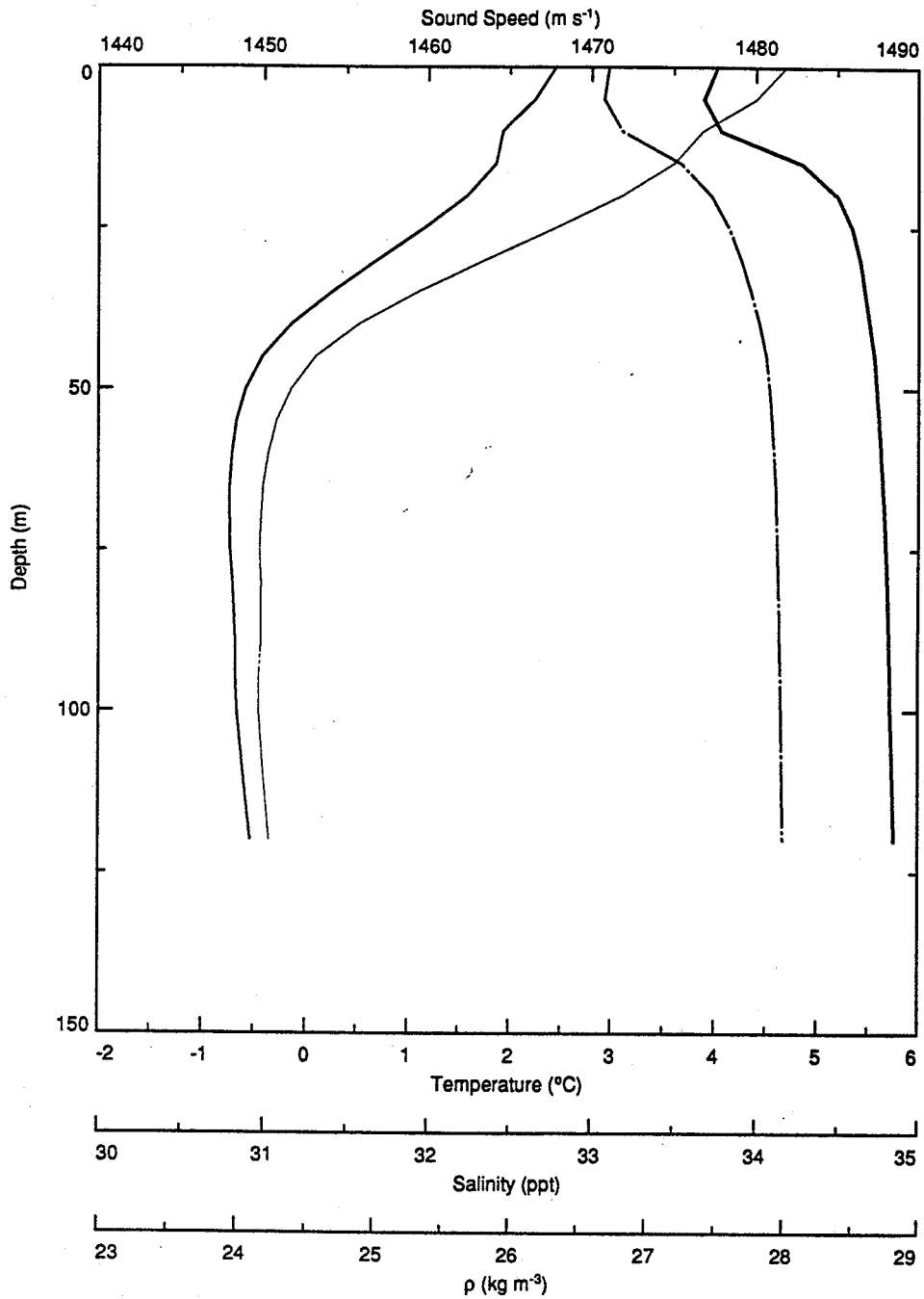


Figure 4.14. Average of all shallow CTD profiles from 1989.

MST 89 - Shallow Casts - Temp

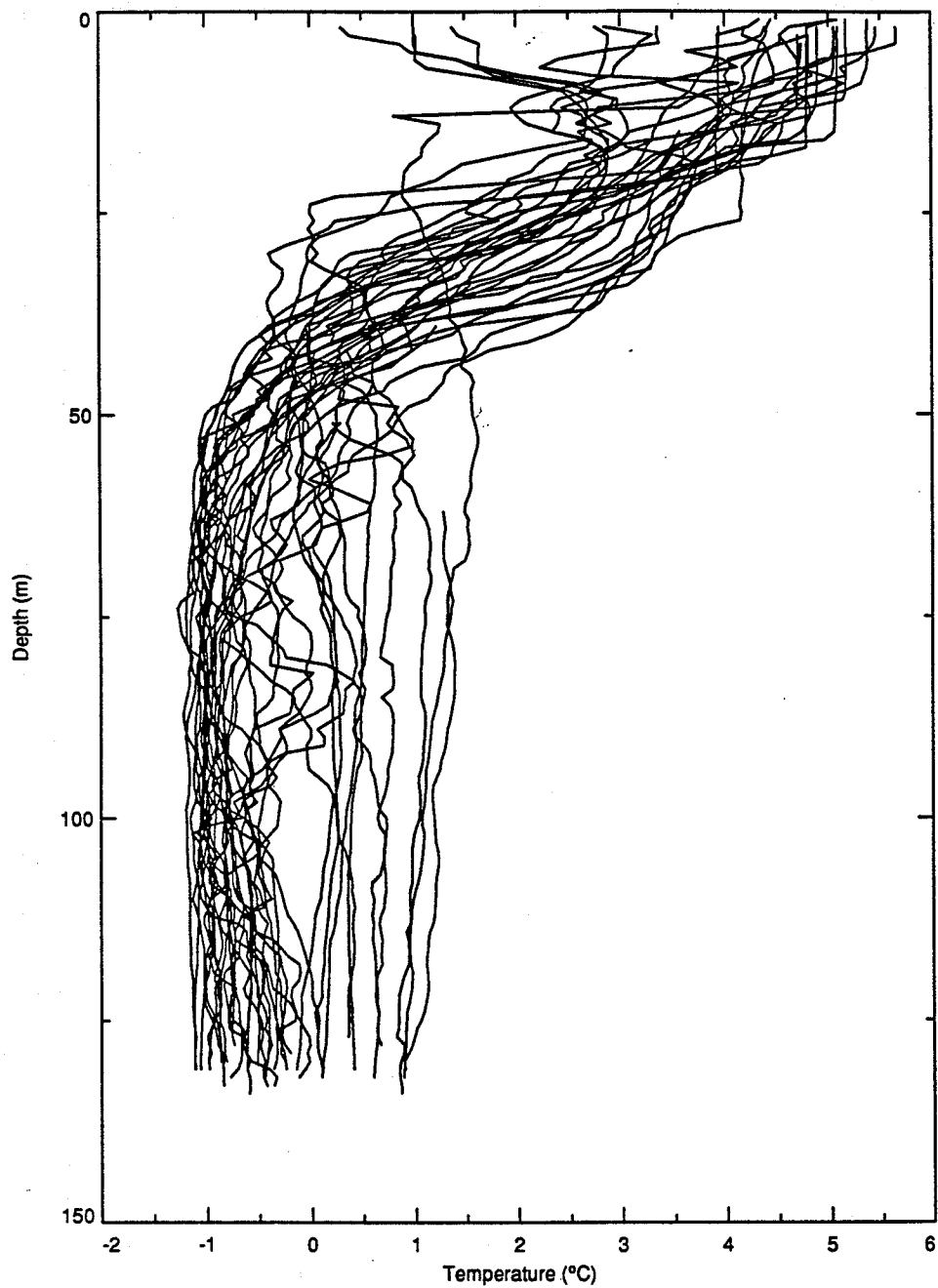


Figure 4.15a. Shallow CTD temperature profiles from 1989.

MST 89 - Shallow Casts - Salinity

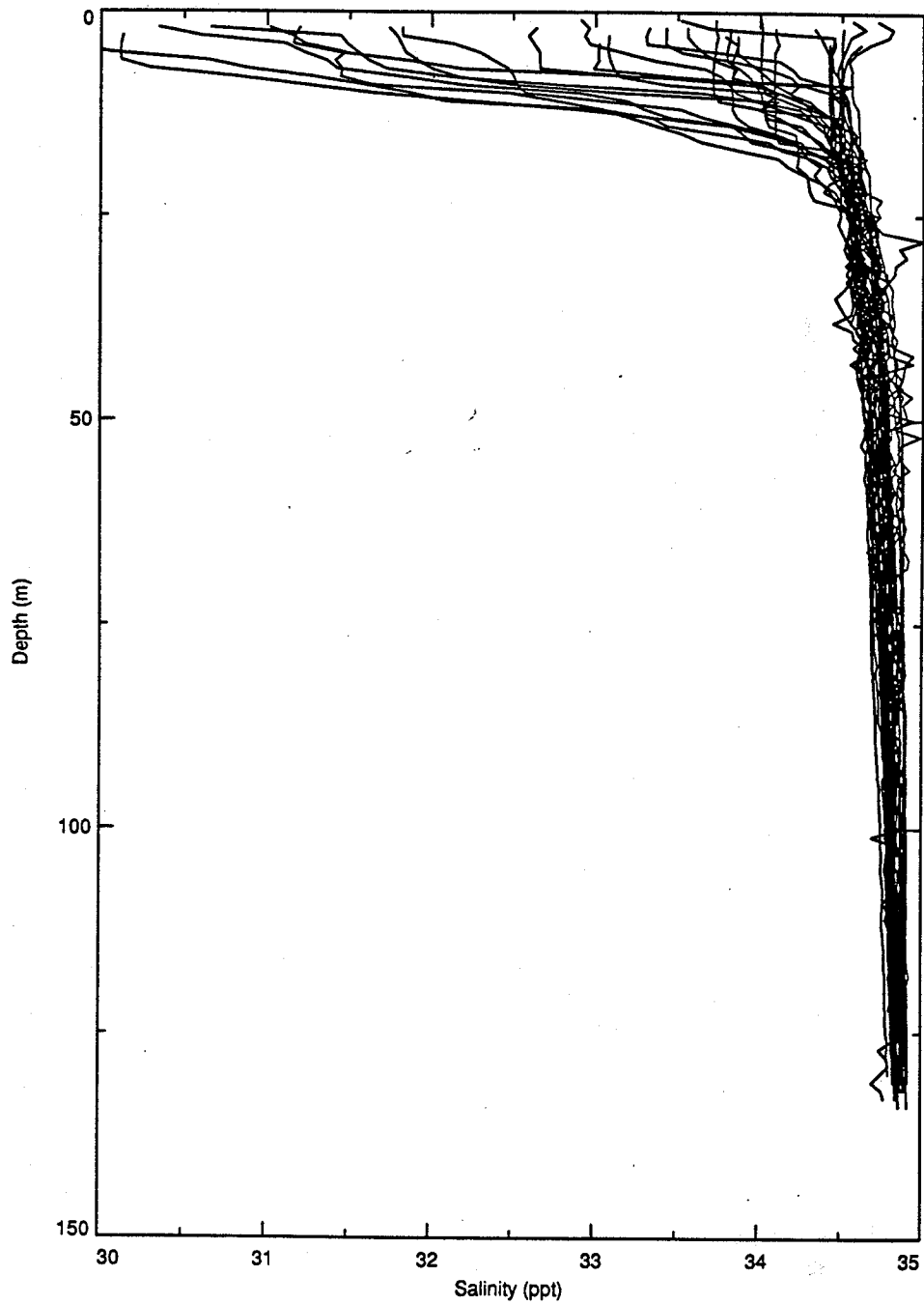


Figure 4.15b. Shallow CTD salinity profiles from 1989.

MST 89 - Shallow Casts - Sound Speed

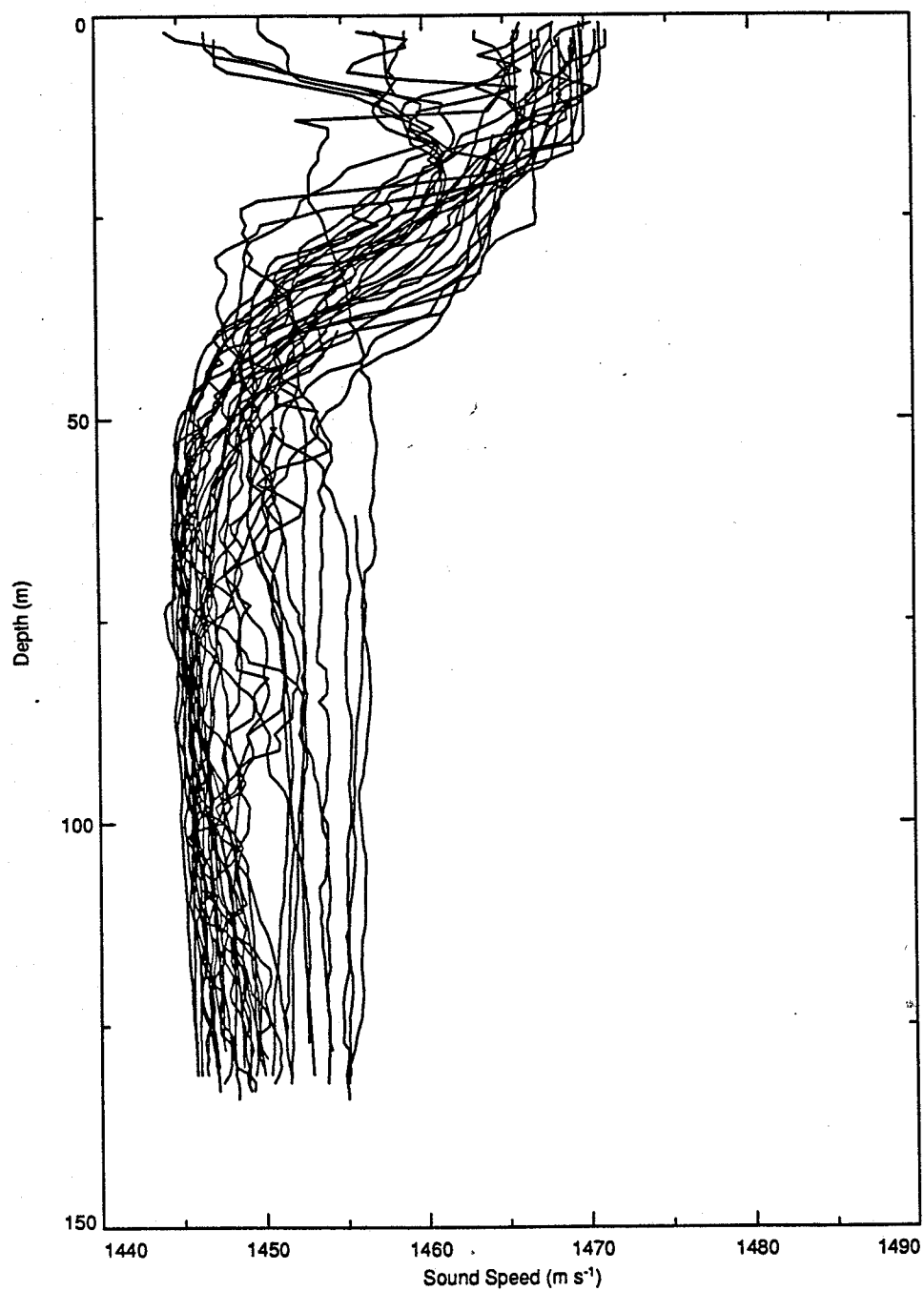


Figure 4.15c. Shallow CTD sound speed profiles from 1989.

MST 89 - Shallow Casts - Density

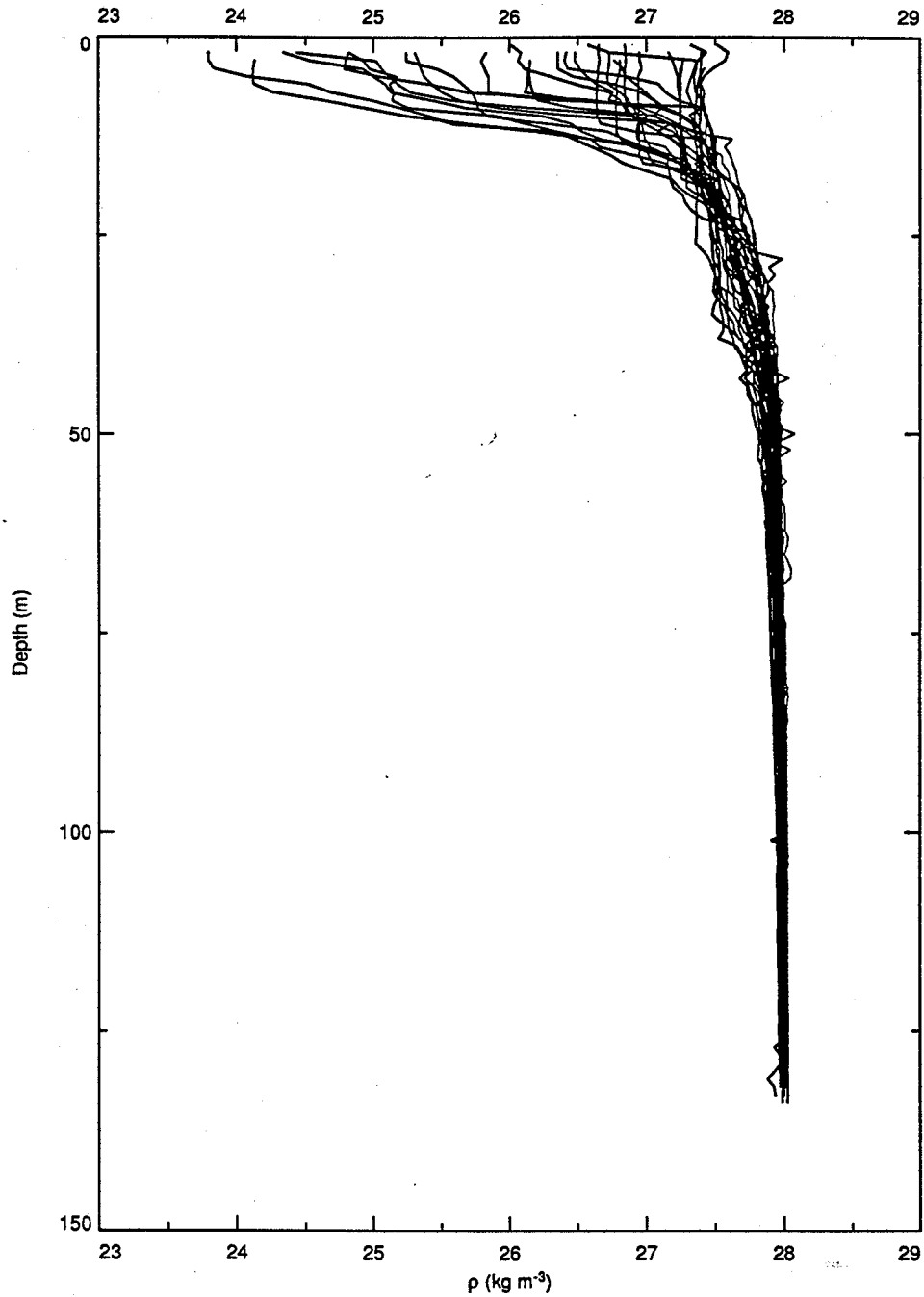


Figure 4.15d. Shallow CTD density profiles from 1989.

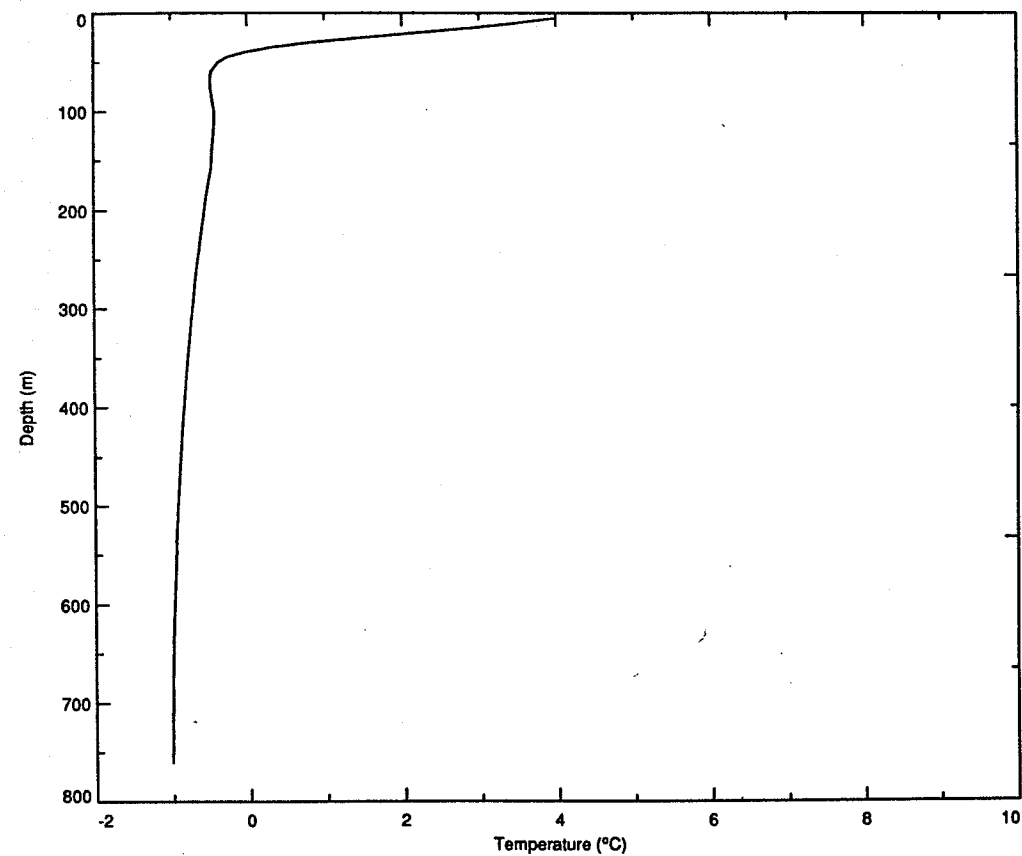


Figure 4.16.
Average of all XBT
profiles from 1989.

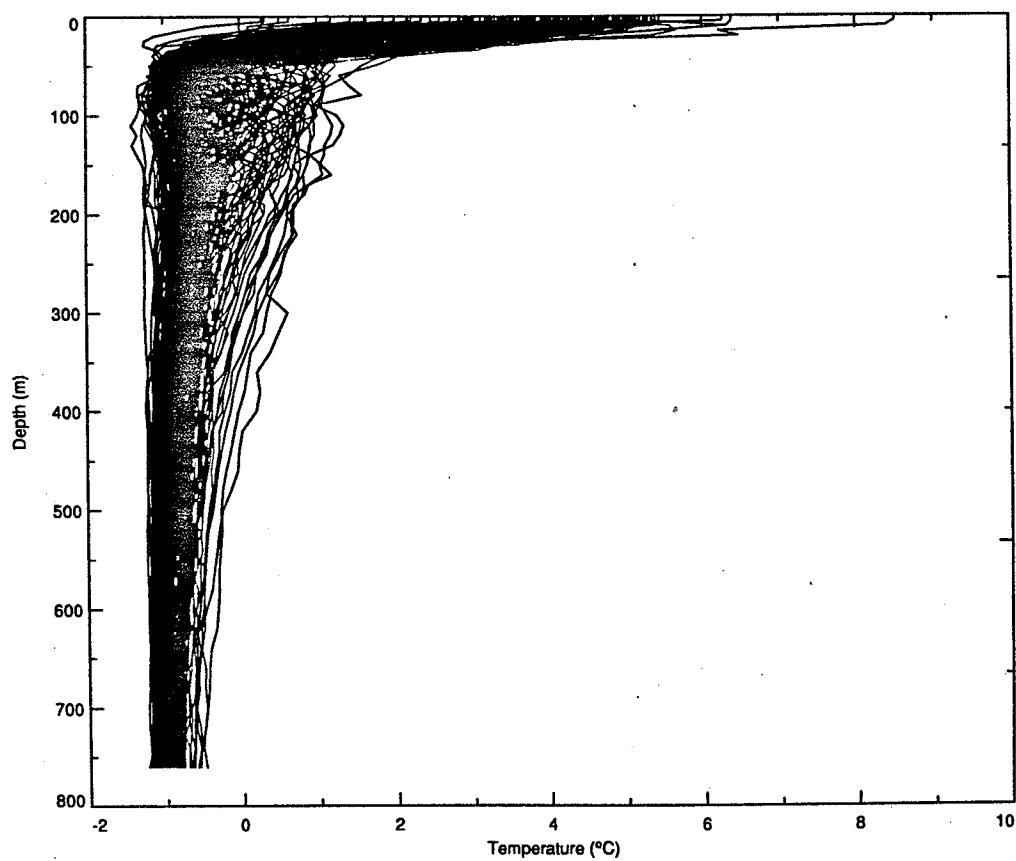


Figure 4.17.
XBT temperature profiles
from 1989.

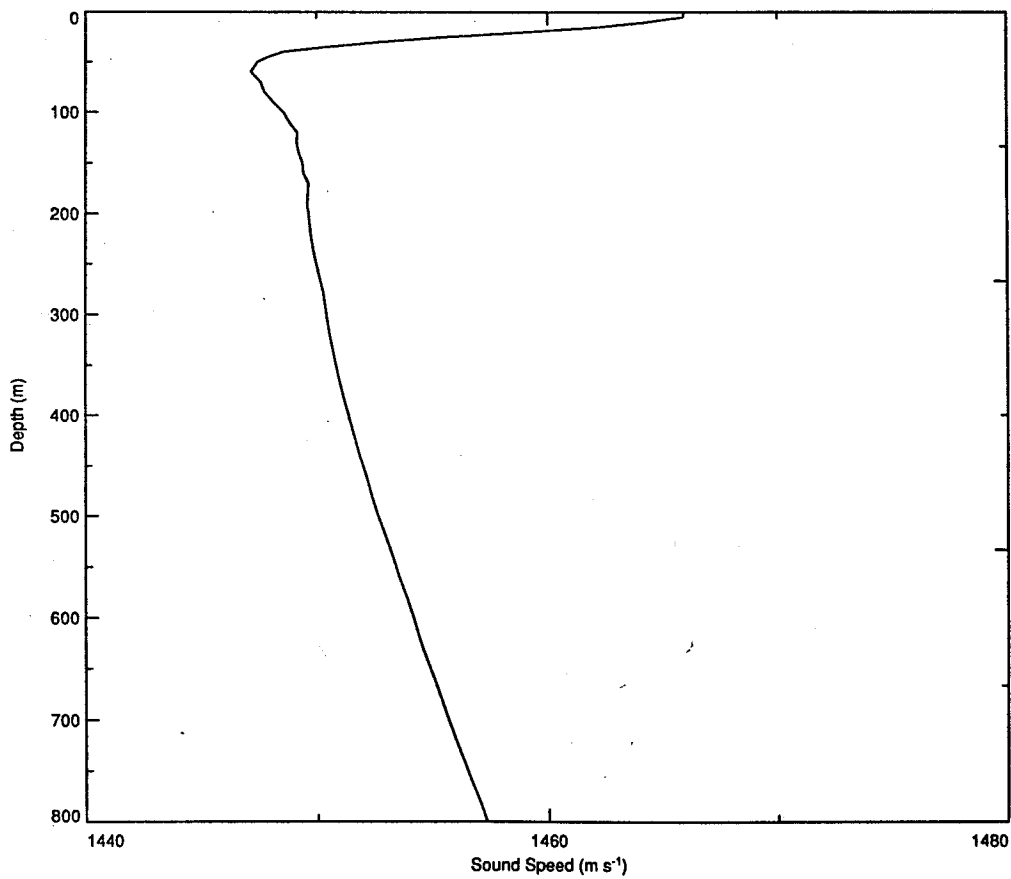


Figure 4.18.
Average of all XSV
profiles from 1989.

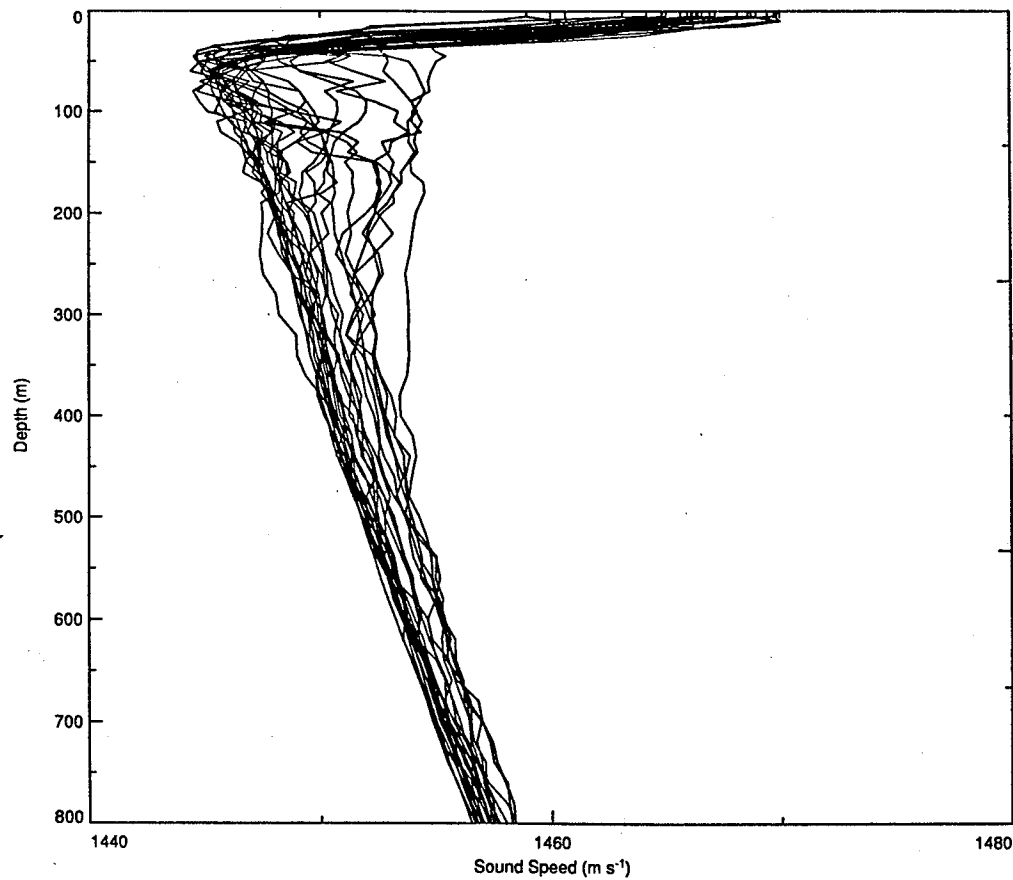


Figure 4.19.
XSV sound speed profiles
from 1989.

APPENDIX A

1988 Log:

Deep CTDs, shallow CTDs (MST), XBTs, and XSVs

Deep CTD Log - 1988

Cast	Year	Day	Date	Time	Lat	Lon	Max Depth
	[1988]			[UTC]	[Deg N]	[Deg E]	[m]
1	261.3910	09/17/88	09:23:00	75.918	-1.850	2757	
2	262.7979	09/18/88	19:09:00	74.533	-5.788	2888	
3	263.8167	09/19/88	19:36:00	75.542	-5.940	2850	
4	264.7882	09/20/88	18:55:00	75.030	-2.827	2878	
5	266.8021	09/22/88	19:15:00	74.998	0.700	2833	
6	267.9125	09/23/88	21:54:00	74.173	-1.848	2891	

Shallow CTD Log - 1988

Cast	Year-Day [1988]	Date	Time [UTC]	Lat [Deg N]	Lon [Deg E]	Max Depth [m]
1	271.3208	09/27/88	07:42:00	74.738	-2.588	123
2	271.4660	09/27/88	11:11:00	74.760	-2.704	124
3	271.6667	09/27/88	16:00:00	74.777	-2.784	126
4	271.8236	09/27/88	19:46:00	74.709	-3.108	117
5	271.9583	09/27/88	23:00:00	74.609	-2.439	124
8	272.9688	09/28/88	23:15:08	74.914	0.035	124
9	273.1379	09/29/88	03:18:38	75.286	0.376	124
10	273.8148	09/29/88	19:33:15	75.034	0.566	124
11	273.9705	09/29/88	23:17:29	75.019	0.437	124
12	274.1392	09/30/88	03:20:23	75.162	1.447	123
13	274.3144	09/30/88	07:32:40	75.358	1.275	121
14	274.4743	09/30/88	11:23:02	75.392	1.193	124
16	275.4822	10/01/88	11:34:20	75.834	0.168	125
18	275.8056	10/01/88	19:20:06	76.161	3.628	124
19	275.9765	10/01/88	23:26:07	76.049	-5.034	122
22	276.4766	10/02/88	11:26:14	75.217	-7.350	124
23	277.4756	10/03/88	11:24:56	74.058	-5.373	125
24	277.6452	10/03/88	15:29:06	73.941	-4.443	122
26	278.4775	10/04/88	11:27:33	74.083	0.600	124
27	278.6448	10/04/88	15:28:34	74.283	0.301	125
28	278.8056	10/04/88	19:20:06	74.542	1.022	120

XBT Log - 1988

Cast	Year	Day	Date	Time	Lat	Lon	Max Depth
	[1988]			[UTC]	[Deg N]	[Deg E]	[m]
1	256.4514	09/12/88	10:50:00	74.003	-1.087	740	
2	256.5139	09/12/88	12:20:00	74.078	-1.288	740	
3	256.5493	09/12/88	13:11:00	74.187	-1.602	740	
4	256.6389	09/12/88	15:20:00	74.283	-1.828	740	
5	256.6667	09/12/88	16:00:00	74.367	-2.057	740	
6	256.6979	09/12/88	16:45:00	74.457	-2.312	740	
7	256.7569	09/12/88	18:09:59	74.637	-2.825	740	
8	256.7847	09/12/88	18:49:59	74.720	-3.073	740	
9	256.8153	09/12/88	19:34:00	74.812	-3.342	740	
10	256.8479	09/12/88	20:21:00	74.898	-3.613	740	
11	256.8785	09/12/88	21:04:59	74.988	-3.882	740	
12	256.9063	09/12/88	21:45:00	75.078	-4.162	740	
13	256.9340	09/12/88	22:25:00	75.158	-4.413	740	
14	256.9632	09/12/88	23:06:59	75.243	-4.682	740	
15	256.9931	09/12/88	23:50:00	75.330	-4.968	740	
16	257.0229	09/13/88	00:33:00	75.415	-5.252	740	
17	257.0528	09/13/88	01:16:00	75.498	-5.553	740	
18	257.0806	09/13/88	01:56:00	75.575	-5.833	360	
19	259.9312	09/15/88	22:20:59	75.623	-5.667	740	
20	259.9618	09/15/88	23:05:00	75.663	-5.250	740	
21	259.9937	09/15/88	23:50:59	75.703	-4.833	740	
22	260.0368	09/16/88	00:53:00	75.742	-4.413	740	
23	260.0847	09/16/88	02:01:59	75.780	-3.990	740	
24	260.1285	09/16/88	03:04:59	75.818	-3.565	580	
25	260.1750	09/16/88	04:12:00	75.855	-3.138	420	
26	260.2083	09/16/88	04:59:59	75.890	-2.710	740	
27	260.2326	09/16/88	05:35:00	75.925	-2.278	740	
28	260.2660	09/16/88	06:22:59	75.960	-1.845	740	
29	261.7188	09/17/88	17:15:00	75.870	-2.115	740	
30	261.7493	09/17/88	17:59:00	75.778	-2.382	740	
31	261.7813	09/17/88	18:45:00	75.687	-2.645	300	
32	261.8868	09/17/88	21:17:00	75.503	-3.163	740	
33	261.9167	09/17/88	22:00:00	75.412	-3.417	740	
34	261.9458	09/17/88	22:41:59	75.320	-3.668	740	
35	262.0056	09/18/88	00:08:00	75.133	-4.160	740	
36	262.0347	09/18/88	00:49:59	75.040	-4.402	740	
37	262.0646	09/18/88	01:32:59	74.947	-4.640	740	

38	262.0944	09/18/88	02:15:59	74.853	-4.877	280
39	262.1632	09/18/88	03:54:59	74.645	-5.392	240
40	262.1868	09/18/88	04:29:00	74.572	-5.567	740
41	262.2181	09/18/88	05:14:00	74.477	-5.792	740
42	263.4597	09/19/88	11:01:59	74.810	-5.875	740
43	263.4882	09/19/88	11:42:59	74.927	-5.900	180
44	263.5167	09/19/88	12:24:00	75.028	-5.930	740
45	263.6563	09/19/88	15:45:00	75.137	-5.950	740
46	263.6861	09/19/88	16:27:59	75.248	-5.987	740
47	263.7201	09/19/88	17:17:00	75.377	-6.025	740
48	263.9764	09/19/88	23:26:00	75.457	-5.295	740
49	264.0083	09/20/88	00:11:59	75.392	-4.892	740
50	264.0389	09/20/88	00:56:00	75.327	-4.503	740
51	264.0764	09/20/88	01:50:00	75.250	-4.027	740
52	264.0993	09/20/88	02:23:00	75.195	-3.735	740
53	264.1306	09/20/88	03:08:00	75.128	-3.357	740
54	264.1611	09/20/88	03:51:59	75.062	-2.980	740
55	265.6319	09/21/88	15:09:59	75.175	-2.845	740
56	265.7048	09/21/88	16:54:59	75.398	-2.570	740
57	265.7423	09/21/88	17:48:59	75.502	-2.427	740
58	265.7778	09/21/88	18:40:00	75.627	-2.285	740
59	265.8125	09/21/88	19:30:00	75.735	-2.142	340
60	265.8472	09/21/88	20:19:59	75.847	-1.965	740
61	265.8729	09/21/88	20:57:00	75.927	-1.838	740
62	265.8972	09/21/88	21:31:59	75.870	-1.580	740
63	265.9236	09/21/88	22:09:59	75.780	-1.330	740
64	265.9514	09/21/88	22:50:00	75.690	-1.058	740
65	265.9792	09/21/88	23:30:00	75.605	-0.815	740
66	266.0104	09/22/88	00:15:00	75.508	-0.548	740
67	266.0382	09/22/88	00:54:59	75.422	-0.305	740
68	266.0757	09/22/88	01:48:59	75.300	-0.005	740
69	266.0979	09/22/88	02:21:00	75.232	0.187	740
70	266.1250	09/22/88	03:00:00	75.142	0.427	740
71	266.1542	09/22/88	03:42:00	75.052	0.667	740
72	267.5854	09/23/88	14:03:00	74.962	0.405	740
73	267.6146	09/23/88	14:44:59	74.875	0.143	740
74	267.6423	09/23/88	15:24:59	74.787	-0.117	620
75	267.6840	09/23/88	16:25:00	74.667	-0.475	240
76	267.7000	09/23/88	16:47:59	74.612	-0.628	740
77	267.7278	09/23/88	17:28:00	74.523	-0.880	70
78	267.7361	09/23/88	17:39:59	74.488	-0.977	260
79	267.7563	09/23/88	18:09:00	74.433	-1.137	740

80	267.7854	09/23/88	18:51:00	74.347	-1.375	740
81	267.8139	09/23/88	19:32:00	74.253	-1.632	740
82	267.8423	09/23/88	20:12:59	74.168	-1.857	740
83	268.8806	09/24/88	21:08:00	74.202	-2.243	740
84	268.9125	09/24/88	21:54:00	74.235	-2.632	680
85	268.9438	09/24/88	22:39:00	74.268	-3.022	740
86	268.9764	09/24/88	23:26:00	74.300	-3.413	400
87	269.0076	09/25/88	00:11:00	74.332	-3.807	740
88	269.0396	09/25/88	00:56:59	74.362	-4.200	740
89	269.0715	09/25/88	01:43:00	74.392	-4.597	740
90	269.1062	09/25/88	02:32:59	74.420	-4.993	740
91	269.1410	09/25/88	03:22:59	74.448	-5.393	260
92	269.2153	09/25/88	05:10:00	74.558	-5.010	740
93	269.2764	09/25/88	06:38:00	74.598	-4.600	740
94	269.3368	09/25/88	08:05:00	74.637	-4.220	740
95	269.4035	09/25/88	09:40:59	74.675	-3.823	740
96	269.4688	09/25/88	11:15:00	74.718	-3.380	740
97	269.5201	09/25/88	12:29:00	74.750	-3.022	240
98	269.5944	09/25/88	14:15:59	74.785	-2.618	740
99	269.6465	09/25/88	15:31:00	74.822	-2.213	740
100	269.6465	09/25/88	15:31:00	74.855	-1.813	740
101	269.6465	09/25/88	15:31:00	74.890	-1.397	740
102	269.8194	09/25/88	19:39:59	74.928	-0.852	740
103	269.8576	09/25/88	20:35:00	74.955	-0.580	200
104	269.8986	09/25/88	21:33:59	74.987	-0.158	740
105	269.9444	09/25/88	22:39:59	75.023	0.303	740
106	270.0194	09/26/88	00:27:59	75.057	-0.240	220
107	270.0548	09/26/88	01:18:59	75.060	-0.697	740
108	270.0889	09/26/88	02:08:00	75.063	-1.177	740
109	270.1250	09/26/88	03:00:00	75.063	-1.665	620
110	270.1535	09/26/88	03:40:59	75.063	-2.067	300
111	270.1861	09/26/88	04:27:59	75.063	-2.523	740
112	270.2410	09/26/88	05:46:59	74.950	-2.832	740
113	270.2708	09/26/88	06:29:59	74.838	-2.687	740
114	270.2944	09/26/88	07:03:59	74.770	-2.602	740
115	270.9618	09/26/88	23:05:00	74.617	-2.425	680
116	277.7535	10/03/88	18:04:59	73.913	-4.070	740
117	278.6042	10/04/88	14:30:00	74.222	-0.003	740
118	278.7535	10/04/88	18:04:59	74.387	0.628	740

XSV Log - 1988

Cast	Year-Day [1988]	Date	Time [UTC]	Lat [Deg N]	Lon [Deg E]	Max Depth [m]
1	255.7917	09/11/88	18:59:59	74.742	-3.133	800
2	255.9132	09/11/88	21:55:01	75.078	-4.162	800
3	258.9007	09/14/88	21:37:00	75.582	-6.080	800
4	258.9993	09/14/88	23:58:59	75.712	-4.735	45
5	259.1799	09/15/88	04:19:00	75.863	-3.047	800
6	259.2778	09/15/88	06:39:59	75.960	-1.845	800
7	260.8785	09/16/88	21:05:00	75.552	-3.028	540
8	261.1021	09/17/88	02:26:59	74.835	-4.923	800
9	262.4688	09/18/88	11:15:00	74.843	-5.885	800
10	262.6986	09/18/88	16:45:59	75.293	-5.997	800
11	263.0458	09/19/88	01:06:00	75.312	-4.420	800
12	263.1667	09/19/88	03:59:59	75.067	-3.017	800
13	264.7493	09/20/88	17:58:59	75.543	-2.388	800
14	264.9583	09/20/88	23:00:00	75.690	-1.058	800
15	265.0833	09/21/88	02:00:00	75.277	0.063	800
16	265.1597	09/21/88	03:50:00	75.052	0.667	800
17	266.6493	09/22/88	15:34:58	74.767	-0.167	800
18	267.9514	09/23/88	22:49:59	74.272	-3.072	800
19	268.3438	09/24/88	08:15:00	74.640	-4.197	800
20	268.6042	09/24/88	14:29:59	74.795	-2.545	800
21	268.8285	09/24/88	19:52:59	74.935	-0.860	800
22	269.0972	09/25/88	02:20:00	75.062	-1.270	800
23	270.0354	09/26/88	00:51:01	74.602	-2.478	800
24	278.4215	10/04/88	10:07:00	74.085	-1.267	800

APPENDIX B

1989 Log:

Deep CTDs, shallow CTDs (MST), XBTs, and XSVs

Deep CTD Log - 1989

Cast	Year	Day	Date	Time	Lat	Lon	Max Depth
	[1989]			[UTC]	[Deg N]	[Deg E]	[m]
1	248.3542	09/05/89	08:30:00	75.003	-2.450	3614	
2	248.8354	09/05/89	20:03:00	74.343	-5.192	3437	
4	249.5083	09/06/89	12:12:00	75.597	-5.542	3404	
5	249.9361	09/06/89	22:28:00	75.605	-1.987	3657	
6	250.6146	09/07/89	14:45:00	75.050	0.783	3692	
7	251.6903	09/08/89	16:34:00	74.148	-3.027	3585	

Shallow CTD Log - 1989

Cast	Year	Day	Date	Time	Lat	Lon	Max Depth
	[1989]			[UTC]	[Deg N]	[Deg E]	[m]
1	216.6428	08/04/89	15:25:42	72.613	11.029	128	
15	217.9900	08/05/89	23:45:38	75.217	2.268	130	
16	218.1517	08/06/89	03:38:23	75.649	1.847	132	
17	218.3195	08/06/89	07:40:06	76.021	0.831	130	
18	218.4833	08/06/89	11:35:54	76.252	0.514	131	
19	218.6429	08/06/89	15:25:48	76.414	-2.709	131	
21	218.9897	08/06/89	23:45:06	76.155	-5.068	130	
23	219.3141	08/07/89	07:32:15	75.840	-6.540	126	
25	219.6458	08/07/89	15:30:01	75.702	-6.191	133	
26	220.8246	08/07/88	19:47:25	75.328	-6.096	127	
28	220.1514	08/08/89	03:38:04	75.034	-8.122	132	
29	220.3076	08/08/89	07:22:55	74.442	-7.522	132	
31	220.6396	08/08/89	15:21:03	73.810	-4.884	130	
32	220.8157	08/08/89	19:34:39	73.704	-3.272	132	
33	220.9875	08/08/89	23:41:58	73.771	-1.272	131	
34	221.1573	08/09/89	03:46:29	74.025	0.206	131	
35	221.3229	08/09/89	07:45:00	74.447	0.712	133	

36	221.4852	08/09/89	11:38:42	74.883	1.181	131
37	221.6528	08/09/89	15:39:58	75.320	1.135	128
38	221.8210	08/09/89	19:42:12	75.700	0.567	131
39	221.9822	08/09/89	23:34:22	76.078	0.585	128
40	222.1546	08/10/89	03:42:36	76.366	-1.845	128
41	222.3162	08/10/89	07:35:19	75.875	-1.802	131
42	222.4899	08/10/89	11:45:27	75.456	-1.852	132
44	222.8167	08/10/89	19:36:04	74.380	-1.883	127
45	222.9885	08/10/89	23:43:24	73.859	-1.879	126
46	223.1571	08/11/89	03:46:10	74.061	-1.855	130
50	223.8204	08/11/89	19:41:22	75.152	-4.809	131
51	223.9844	08/11/89	23:37:29	75.568	-6.138	133
52	224.1485	08/12/89	03:33:49	75.667	-6.305	129
53	224.3232	08/12/89	07:45:28	75.552	-6.269	132
54	224.4901	08/12/89	11:45:42	75.673	-5.103	134
55	224.6568	08/12/89	15:45:49	75.841	-3.363	131
56	224.8176	08/12/89	19:37:18	75.967	-1.983	131
58	225.1522	08/13/89	03:39:08	75.676	-2.706	129
59	225.3224	08/13/89	07:44:16	75.239	-3.892	131
61	225.6572	08/13/89	15:46:24	74.723	-5.182	134
63	225.9909	08/13/89	23:46:53	74.286	-3.349	130
64	226.1561	08/14/89	03:44:44	74.141	-1.674	131

XBT Log - 1989

Cast	Year-Day [1989]	Date	Time [UTC]	Lat [Deg N]	Lon [Deg E]	Max Depth [m]
1	216.5611	08/04/89	13:27:59	74.121	0.552	760
2	216.6250	08/04/89	15:00:00	74.288	1.230	760
3	216.6813	08/04/89	16:21:00	74.349	1.329	760
4	216.7361	08/04/89	17:39:59	74.515	1.685	760
5	216.7604	08/04/89	18:15:00	74.618	1.902	760
6	216.8646	08/04/89	20:44:59	74.781	2.089	760
7	216.8903	08/04/89	21:22:00	74.905	2.158	760
8	216.9236	08/04/89	22:09:59	75.064	2.242	760
9	217.0278	08/05/89	00:40:00	75.221	2.265	760
10	217.0590	08/05/89	01:25:00	75.359	2.139	760
11	217.0903	08/05/89	02:10:00	75.496	1.987	760
12	217.1965	08/05/89	04:43:00	75.670	1.845	760
13	217.2562	08/05/89	06:08:59	75.895	1.171	760
14	217.4097	08/05/89	09:49:59	76.112	0.260	760
15	217.4410	08/05/89	10:34:59	76.204	0.223	760
16	217.5660	08/05/89	13:34:59	76.327	-1.475	760
17	217.5958	08/05/89	14:17:59	76.366	-2.053	760
18	217.7069	08/05/89	16:57:59	76.389	-2.851	760
19	217.7292	08/05/89	17:30:00	76.380	-3.306	760
20	217.7639	08/05/89	18:20:00	76.369	-3.999	760
21	217.8403	08/05/89	20:10:00	76.335	-4.414	760
22	218.0208	08/06/89	00:29:59	76.153	-5.060	760
23	218.0833	08/06/89	01:59:59	76.042	-4.957	760
24	218.1923	08/06/89	04:36:59	75.942	-5.085	760
25	218.2417	08/06/89	05:48:00	75.885	-5.655	760
26	218.2903	08/06/89	06:58:00	75.827	-6.491	760
27	218.4132	08/06/89	09:54:59	75.713	-6.688	760
28	218.5681	08/06/89	13:38:00	75.511	-6.763	760
29	218.9132	08/06/89	21:54:59	75.294	-6.741	760
30	218.9548	08/06/89	22:54:59	75.307	-7.531	760
31	219.0597	08/07/89	01:25:59	75.184	-8.117	760
32	219.1042	08/07/89	02:30:00	75.031	-8.112	740
33	219.1882	08/07/89	04:30:59	74.880	-8.071	760
34	219.2298	08/07/89	05:30:59	74.719	-7.881	760
35	219.2639	08/07/89	06:20:00	74.560	-7.687	760
36	219.3923	08/07/89	09:24:59	74.352	-7.228	760
37	219.4375	08/07/89	10:30:00	74.194	-6.734	740

38	219.5403	08/07/89	12:58:00	74.041	-6.234	760
39	219.5701	08/07/89	13:41:00	73.966	-5.798	760
40	219.6014	08/07/89	14:26:00	73.886	-5.334	100
41	219.6813	08/07/89	16:21:00	73.814	-4.861	760
42	219.7278	08/07/89	17:28:00	73.777	-4.287	740
43	219.7583	08/07/89	18:11:59	73.740	-3.774	760
44	219.8625	08/07/89	20:42:00	73.696	-3.304	760
45	219.9132	08/07/89	21:54:59	73.723	-2.607	760
46	219.9444	08/07/89	22:39:59	73.747	-2.092	760
47	220.0229	08/08/89	00:33:00	73.777	-1.563	760
48	220.0660	08/08/89	01:34:59	73.881	-1.061	760
49	220.0958	08/08/89	02:17:59	73.960	-0.682	760
50	220.1910	08/08/89	04:34:59	74.034	-0.184	760
51	220.2375	08/08/89	05:42:00	74.223	0.256	760
52	220.2604	08/08/89	06:15:00	74.317	0.478	760
53	220.4118	08/08/89	09:53:00	74.628	0.951	760
54	220.5292	08/08/89	12:42:00	74.889	1.149	760
55	220.5618	08/08/89	13:29:00	75.031	1.148	760
56	220.5958	08/08/89	14:17:59	75.179	1.137	760
57	220.6861	08/08/89	16:27:59	75.322	1.102	740
58	220.7236	08/08/89	17:21:59	75.435	0.930	760
59	220.7569	08/08/89	18:09:59	75.582	0.717	760
60	220.8993	08/08/89	21:35:00	75.849	0.216	760
61	220.9319	08/08/89	22:21:59	75.968	-0.157	760
62	221.0208	08/09/89	00:29:59	76.088	-0.609	760
63	221.0535	08/09/89	01:16:59	76.182	-0.975	760
64	221.0535	08/09/89	01:16:59	76.182	-0.975	760
65	221.1923	08/09/89	04:36:59	76.359	-1.847	760
66	221.2021	08/09/89	04:50:59	76.313	-1.861	760
67	221.2111	08/09/89	05:03:59	76.269	-1.835	440
68	221.2229	08/09/89	05:21:00	76.213	-1.845	760
69	221.2333	08/09/89	05:35:59	76.160	-1.842	760
70	221.2465	08/09/89	05:55:00	76.097	-1.840	760
71	221.2556	08/09/89	06:08:00	76.053	-1.841	760
72	221.2694	08/09/89	06:27:59	75.984	-1.841	760
73	221.2729	08/09/89	06:33:00	75.968	-1.842	760
74	221.2792	08/09/89	06:42:00	75.937	-1.841	760
75	221.2910	08/09/89	06:58:59	75.879	-1.844	760
76	221.3660	08/09/89	08:46:59	75.870	-1.784	760
77	221.3764	08/09/89	09:02:00	75.823	-1.867	760
78	221.4167	08/09/89	10:00:00	75.777	-1.855	760
79	221.4313	08/09/89	10:21:00	75.711	-1.855	760

80	221.4410	08/09/89	10:34:59	75.665	-1.849	760
81	221.4514	08/09/89	10:50:00	75.617	-1.853	760
82	221.4618	08/09/89	11:05:00	75.567	-1.852	760
83	221.4743	08/09/89	11:23:00	75.508	-1.854	760
84	221.4840	08/09/89	11:37:00	75.460	-1.853	760
85	221.5403	08/09/89	12:58:00	75.395	-1.853	740
86	221.5514	08/09/89	13:14:00	75.344	-1.855	760
87	221.5625	08/09/89	13:30:00	75.291	-1.857	760
88	221.5736	08/09/89	13:45:59	75.239	-1.858	760
89	221.5854	08/09/89	14:03:00	75.184	-1.859	760
90	221.5965	08/09/89	14:19:00	75.132	-1.859	760
91	221.6083	08/09/89	14:35:59	75.075	-1.862	760
92	221.6194	08/09/89	14:51:59	75.022	-1.862	760
93	221.6333	08/09/89	15:11:59	74.957	-1.863	760
94	221.6417	08/09/89	15:24:00	74.917	-1.863	760
95	221.6535	08/09/89	15:40:59	74.859	-1.862	760
96	221.7000	08/09/89	16:47:59	74.811	-1.877	760
97	221.7118	08/09/89	17:05:00	74.754	-1.868	760
98	221.7229	08/09/89	17:21:00	74.700	-1.865	760
99	221.7340	08/09/89	17:37:00	74.647	-1.867	760
100	221.7458	08/09/89	17:53:59	74.590	-1.869	760
101	221.7569	08/09/89	18:09:59	74.537	-1.869	760
102	221.7681	08/09/89	18:26:00	74.484	-1.869	760
103	221.7798	08/09/89	18:42:59	74.429	-1.871	760
104	221.8826	08/09/89	21:11:00	74.323	-1.883	760
105	221.8958	08/09/89	21:29:59	74.263	-1.875	760
106	221.9063	08/09/89	21:45:00	74.216	-1.876	660
107	221.9201	08/09/89	22:05:00	74.151	-1.877	760
108	221.9292	08/09/89	22:18:00	74.109	-1.877	760
109	221.9417	08/09/89	22:36:00	74.051	-1.875	760
110	221.9535	08/09/89	22:52:59	73.996	-1.880	660
111	221.9701	08/09/89	23:17:00	73.918	-1.884	760
112	221.9771	08/09/89	23:26:59	73.886	-1.882	760
113	222.0375	08/10/89	00:53:59	73.822	-1.868	760
114	222.0465	08/10/89	01:07:00	73.781	-1.883	760
115	222.4278	08/10/89	10:16:00	74.162	-1.942	760
116	222.4389	08/10/89	10:32:00	74.198	-1.999	760
117	222.4507	08/10/89	10:48:59	74.244	-2.117	760
118	222.4618	08/10/89	11:05:00	74.286	-2.232	760
119	222.4729	08/10/89	11:21:00	74.329	-2.345	760
120	222.4854	08/10/89	11:39:00	74.374	-2.471	760
121	222.5375	08/10/89	12:53:59	74.414	-2.588	760

122	222.5493	08/10/89	13:11:00	74.457	-2.702	760
123	222.5618	08/10/89	13:29:00	74.502	-2.829	740
124	222.5736	08/10/89	13:45:59	74.545	-2.951	760
125	222.5861	08/10/89	14:03:59	74.592	-3.082	760
126	222.5965	08/10/89	14:19:00	74.630	-3.194	760
127	222.6083	08/10/89	14:35:59	74.673	-3.323	760
128	222.6201	08/10/89	14:53:00	74.715	-3.443	760
129	222.6319	08/10/89	15:09:59	74.759	-3.565	760
130	222.6438	08/10/89	15:27:00	74.800	-3.691	760
131	222.7000	08/10/89	16:47:59	74.846	-3.825	760
132	222.7125	08/10/89	17:06:00	74.889	-3.947	760
133	222.7250	08/10/89	17:23:59	74.930	-4.076	760
134	222.7375	08/10/89	17:42:00	74.971	-4.203	760
135	222.7507	08/10/89	18:00:59	75.016	-4.338	760
136	222.7625	08/10/89	18:17:59	75.056	-4.460	760
137	222.7750	08/10/89	18:36:00	75.097	-4.593	760
138	222.7875	08/10/89	18:53:59	75.141	-4.728	760
139	222.8736	08/10/89	20:57:59	75.187	-4.864	740
140	222.8861	08/10/89	21:15:59	75.233	-5.014	760
141	222.8951	08/10/89	21:29:00	75.265	-5.125	740
142	222.9076	08/10/89	21:47:00	75.312	-5.265	760
143	222.9306	08/10/89	22:20:00	75.394	-5.537	760
144	222.9486	08/10/89	22:45:59	75.457	-5.752	760
145	222.9542	08/10/89	22:54:00	75.477	-5.813	400
146	222.9660	08/10/89	23:10:59	75.519	-5.952	760
147	222.9764	08/10/89	23:26:00	75.555	-6.071	760
148	223.4201	08/11/89	10:05:00	75.589	-6.132	760
149	223.4354	08/11/89	10:27:00	75.592	-5.938	760
150	223.4479	08/11/89	10:45:00	75.613	-5.728	760
151	223.4597	08/11/89	11:01:59	75.633	-5.532	760
152	223.4722	08/11/89	11:19:59	75.655	-5.317	760
153	223.4833	08/11/89	11:35:59	75.671	-5.127	760
154	223.5528	08/11/89	13:16:00	75.692	-4.931	760
155	223.5653	08/11/89	13:34:00	75.712	-4.731	760
156	223.5785	08/11/89	13:52:59	75.731	-4.515	760
157	223.5917	08/11/89	14:12:00	75.751	-4.307	760
158	223.6035	08/11/89	14:28:59	75.772	-4.114	740
159	223.6173	08/11/89	14:48:59	75.790	-3.896	760
160	223.6312	08/11/89	15:08:59	75.811	-3.673	760
161	223.6423	08/11/89	15:24:59	75.826	-3.487	760
162	223.7125	08/11/89	17:06:00	75.838	-3.392	760
163	223.7188	08/11/89	17:15:00	75.845	-3.286	760

164	223.7319	08/11/89	17:33:59	75.863	-3.075	760
165	223.7451	08/11/89	17:53:00	75.877	-2.861	760
166	223.7576	08/11/89	18:11:00	75.894	-2.652	760
167	223.7701	08/11/89	18:29:00	75.915	-2.441	760
168	223.7819	08/11/89	18:45:59	75.936	-2.242	760
169	223.7944	08/11/89	19:03:59	75.954	-2.030	760
170	224.0528	08/12/89	01:16:00	75.926	-1.975	760
171	224.0667	08/12/89	01:36:00	75.883	-2.082	760
172	224.0798	08/12/89	01:54:59	75.838	-2.226	680
173	224.0931	08/12/89	02:14:00	75.791	-2.355	760
174	224.1035	08/12/89	02:28:59	75.752	-2.454	760
175	224.1181	08/12/89	02:50:00	75.705	-2.606	760
176	224.1958	08/12/89	04:41:59	75.656	-2.745	760
177	224.2048	08/12/89	04:54:59	75.620	-2.855	540
178	224.2139	08/12/89	05:08:00	75.581	-2.960	760
179	224.2264	08/12/89	05:26:00	75.529	-3.099	760
180	224.2368	08/12/89	05:41:00	75.486	-3.216	760
181	224.2479	08/12/89	05:57:00	75.439	-3.338	760
182	224.2590	08/12/89	06:13:00	75.392	-3.464	760
183	224.2694	08/12/89	06:27:59	75.349	-3.584	740
184	224.2792	08/12/89	06:42:00	75.310	-3.699	760
185	224.2903	08/12/89	06:58:00	75.266	-3.828	720
186	224.3792	08/12/89	09:06:00	75.184	-4.018	760
187	224.3931	08/12/89	09:26:00	75.129	-4.152	760
188	224.4028	08/12/89	09:40:00	75.091	-4.251	760
189	224.4139	08/12/89	09:56:00	75.049	-4.364	760
190	224.4250	08/12/89	10:12:00	75.006	-4.484	760
191	224.4375	08/12/89	10:30:00	74.957	-4.606	760
192	224.4479	08/12/89	10:45:00	74.915	-4.702	760
193	224.4597	08/12/89	11:01:59	74.869	-4.815	760
194	224.4715	08/12/89	11:19:00	74.823	-4.928	760
195	224.4826	08/12/89	11:35:00	74.780	-5.043	760
196	224.6486	08/12/89	15:33:59	74.733	-5.156	760
197	224.6944	08/12/89	16:39:59	74.721	-5.194	760
198	224.7028	08/12/89	16:52:00	74.688	-5.269	760
199	224.7132	08/12/89	17:06:59	74.644	-5.366	760
200	224.7243	08/12/89	17:23:00	74.598	-5.472	760
201	224.7354	08/12/89	17:39:00	74.553	-5.590	760
202	224.7465	08/12/89	17:55:00	74.508	-5.705	760
203	224.7743	08/12/89	18:35:00	74.431	-5.632	760
204	224.7840	08/12/89	18:49:00	74.421	-5.458	760
205	224.7951	08/12/89	19:05:00	74.409	-5.322	760

206	224.8875	08/12/89	21:17:59	74.381	-4.880	760
207	224.8993	08/12/89	21:35:00	74.366	-4.684	760
208	224.9104	08/12/89	21:51:00	74.364	-4.505	760
209	224.9160	08/12/89	21:58:59	74.382	-4.439	740
210	224.9403	08/12/89	22:34:00	74.353	-4.043	760
211	224.9521	08/12/89	22:50:59	74.332	-3.858	760
212	224.9632	08/12/89	23:06:59	74.315	-3.678	760
213	224.9750	08/12/89	23:23:59	74.295	-3.483	760
214	225.0368	08/13/89	00:53:00	74.264	-3.101	760
215	225.0479	08/13/89	01:09:00	74.248	-2.915	760
216	225.0590	08/13/89	01:25:00	74.232	-2.728	760
217	225.0701	08/13/89	01:41:00	74.216	-2.541	520
218	225.0813	08/13/89	01:57:00	74.199	-2.351	760
219	225.0923	08/13/89	02:12:59	74.181	-2.167	760
220	225.1042	08/13/89	02:30:00	74.164	-1.972	740
221	225.1146	08/13/89	02:44:59	74.152	-1.805	760
222	225.1250	08/13/89	03:00:00	74.141	-1.664	760
223	225.1979	08/13/89	04:45:00	74.145	-1.589	760
224	225.2083	08/13/89	04:59:59	74.130	-1.411	740
225	225.2188	08/13/89	05:15:00	74.113	-1.238	760
226	225.2292	08/13/89	05:30:00	74.098	-1.065	740
227	225.2396	08/13/89	05:44:59	74.082	-0.893	760
228	225.2500	08/13/89	06:00:00	74.065	-0.728	760
229	225.2604	08/13/89	06:15:00	74.052	-0.552	760
230	225.2708	08/13/89	06:29:59	74.037	-0.382	760
231	225.2813	08/13/89	06:45:00	74.020	-0.217	760
232	225.2917	08/13/89	07:00:00	74.005	-0.049	740

XSV Log - 1989

Cast	Year	Day	Date	Time	Lat	Lon	Max Depth
	[1989]			[UTC]	[Deg N]	[Deg E]	[m]
1	216.5833	08/04/89	13:59:59	74.186	0.790	800	
2	218.5681	08/06/89	13:38:00	75.511	-6.763	800	
3	221.1972	08/09/89	04:43:59	76.336	-1.854	800	
4	221.2465	08/09/89	05:55:00	76.097	-1.840	800	
5	221.3798	08/09/89	09:06:59	75.825	-1.871	520	
6	221.4660	08/09/89	11:10:59	75.549	-1.852	800	
7	221.5660	08/09/89	13:34:59	75.275	-1.856	800	
8	221.6229	08/09/89	14:57:00	75.006	-1.863	800	
9	221.7257	08/09/89	17:24:59	74.687	-1.866	800	
10	221.7826	08/09/89	18:47:00	74.416	-1.874	800	
11	221.9153	08/09/89	21:58:00	74.174	-1.875	800	
12	221.9563	08/09/89	22:57:00	73.983	-1.881	120	
13	222.4313	08/10/89	10:21:00	74.165	-1.963	800	
14	222.5264	08/10/89	12:38:00	74.374	-2.523	800	
15	222.5889	08/10/89	14:08:00	74.603	-3.112	800	
16	222.6458	08/10/89	15:29:59	74.807	-3.711	800	
17	222.7535	08/10/89	18:04:59	75.025	-4.368	800	
18	222.8861	08/10/89	21:15:59	75.233	-5.014	800	
19	222.9465	08/10/89	22:43:00	75.450	-5.727	800	
20	223.5556	08/11/89	13:20:00	75.694	-4.885	800	
21	223.6208	08/11/89	14:53:59	75.796	-3.844	800	
22	223.7361	08/11/89	17:39:59	75.865	-3.005	800	
23	223.7979	08/11/89	19:09:00	75.961	-1.978	800	
24	224.0278	08/12/89	00:40:00	75.963	-2.252	800	
25	224.1076	08/12/89	02:35:00	75.739	-2.495	800	
26	224.2264	08/12/89	05:26:00	75.529	-3.099	800	
27	224.2792	08/12/89	06:42:00	75.310	-3.699	800	
28	224.4167	08/12/89	10:00:00	75.038	-4.395	800	
29	224.4750	08/12/89	11:23:59	74.809	-4.962	800	
30	224.7160	08/12/89	17:10:59	74.632	-5.392	800	
31	224.7500	08/12/89	18:00:00	74.495	-5.742	800	
32	224.8910	08/12/89	21:22:59	74.377	-4.822	800	
33	224.9465	08/12/89	22:43:00	74.341	-3.946	800	

APPENDIX C

Plots of Raw Profile Data for the 1988 Cruise

The plots of the raw profile data presented in this appendix are ordered as follows:

Deep CTD casts (labeled GSP Deployment CTD cast #,
where # is the cast number given in the log)

Shallow CTD casts (labeled 1988 MST: CTD cast #)

Waterfall plots of XBT profiles (labeled MST 88 XBT Drops # - #)

Waterfall plots of XSV profiles (labeled MST88 XSV Drops # - #).

For the CTD plots, the key is as follows:

Temperature = thin line

Salinity = heavy line,

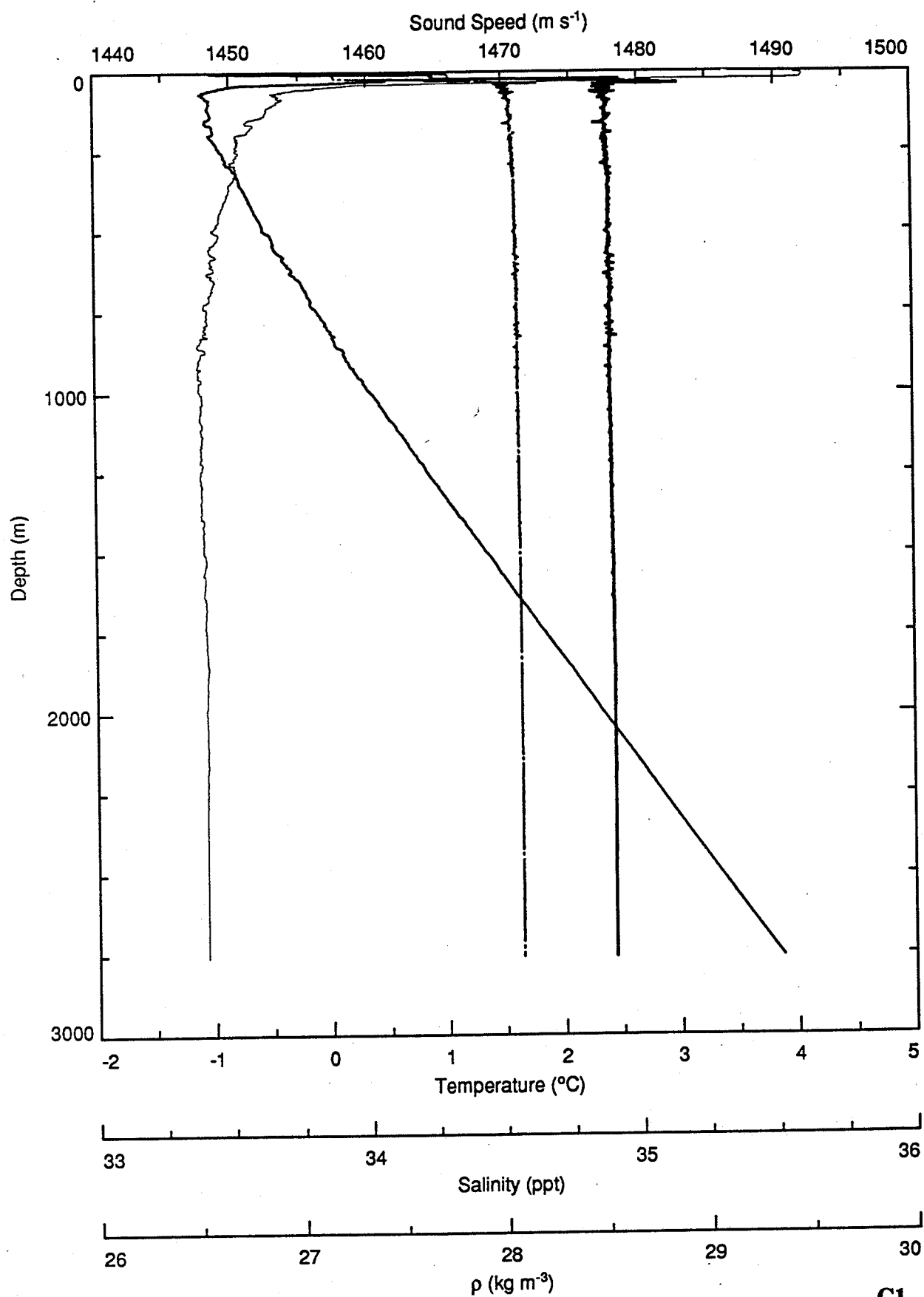
Sound speed = medium line

Density (σ_θ) = dashed line.

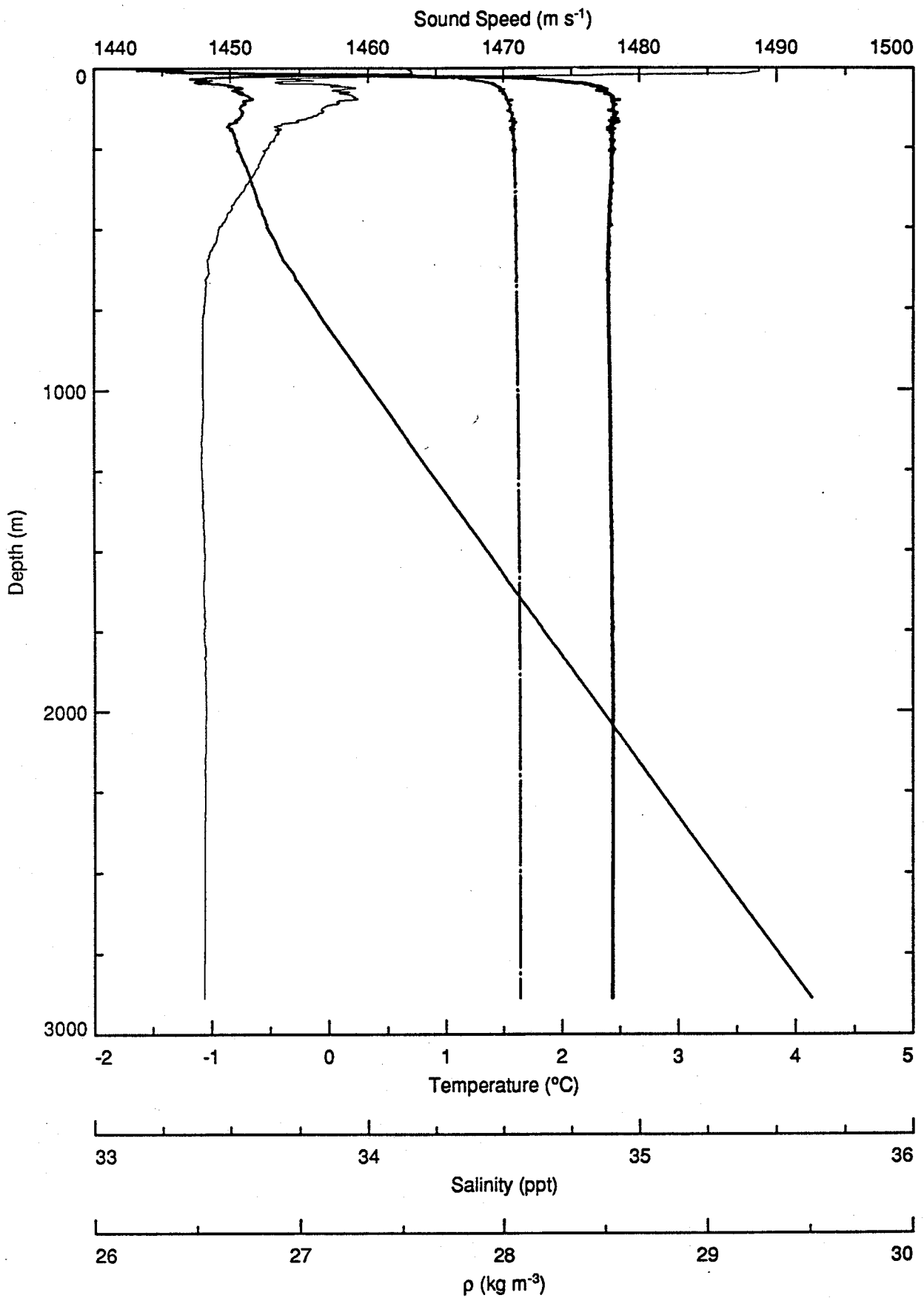
For the XBT waterfall plots, the profiles are offset by 0.5°C.

For the XSV waterfall plots, the profiles are offset by 10 m/s.

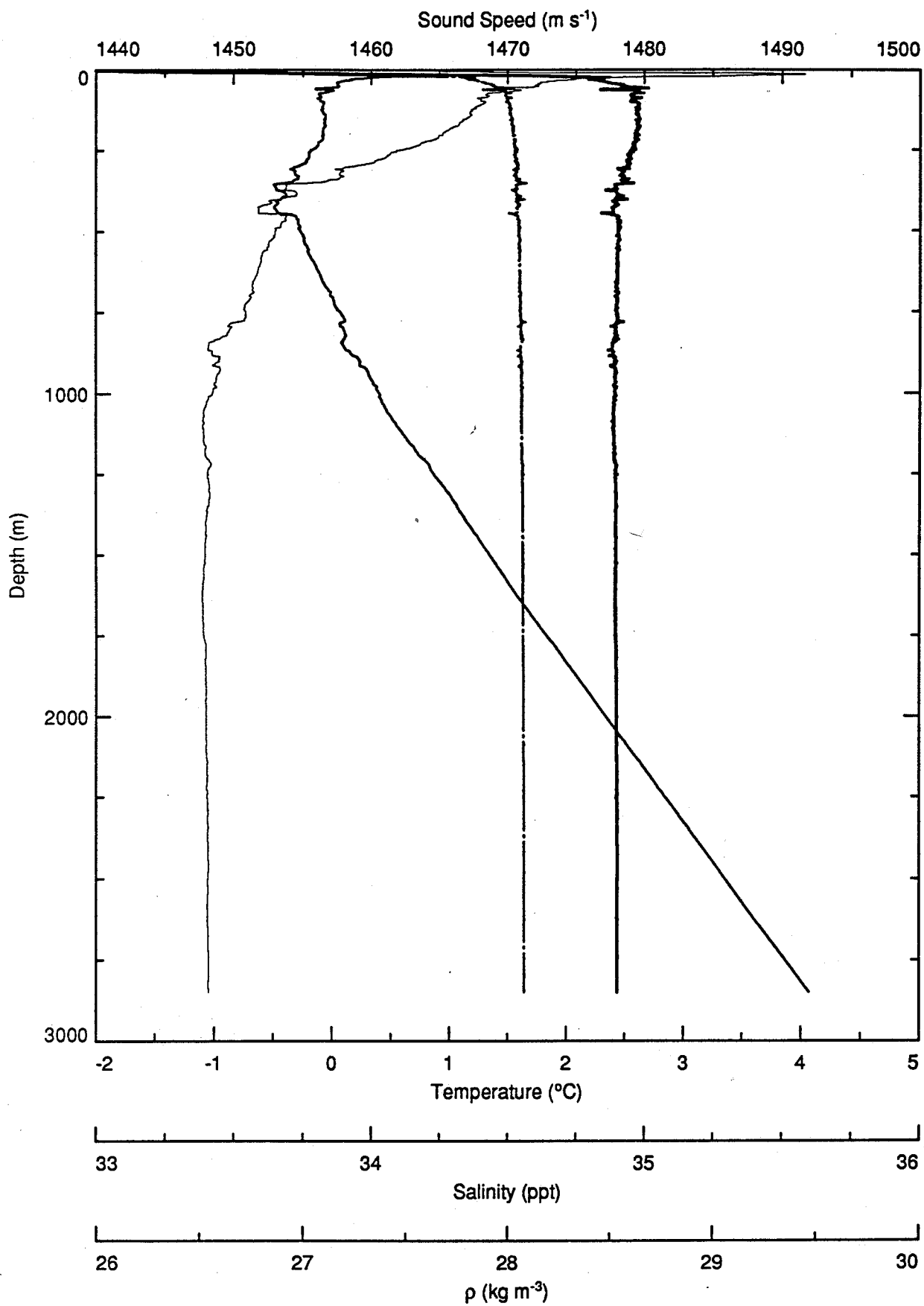
GSP Deployment CTD Cast 001



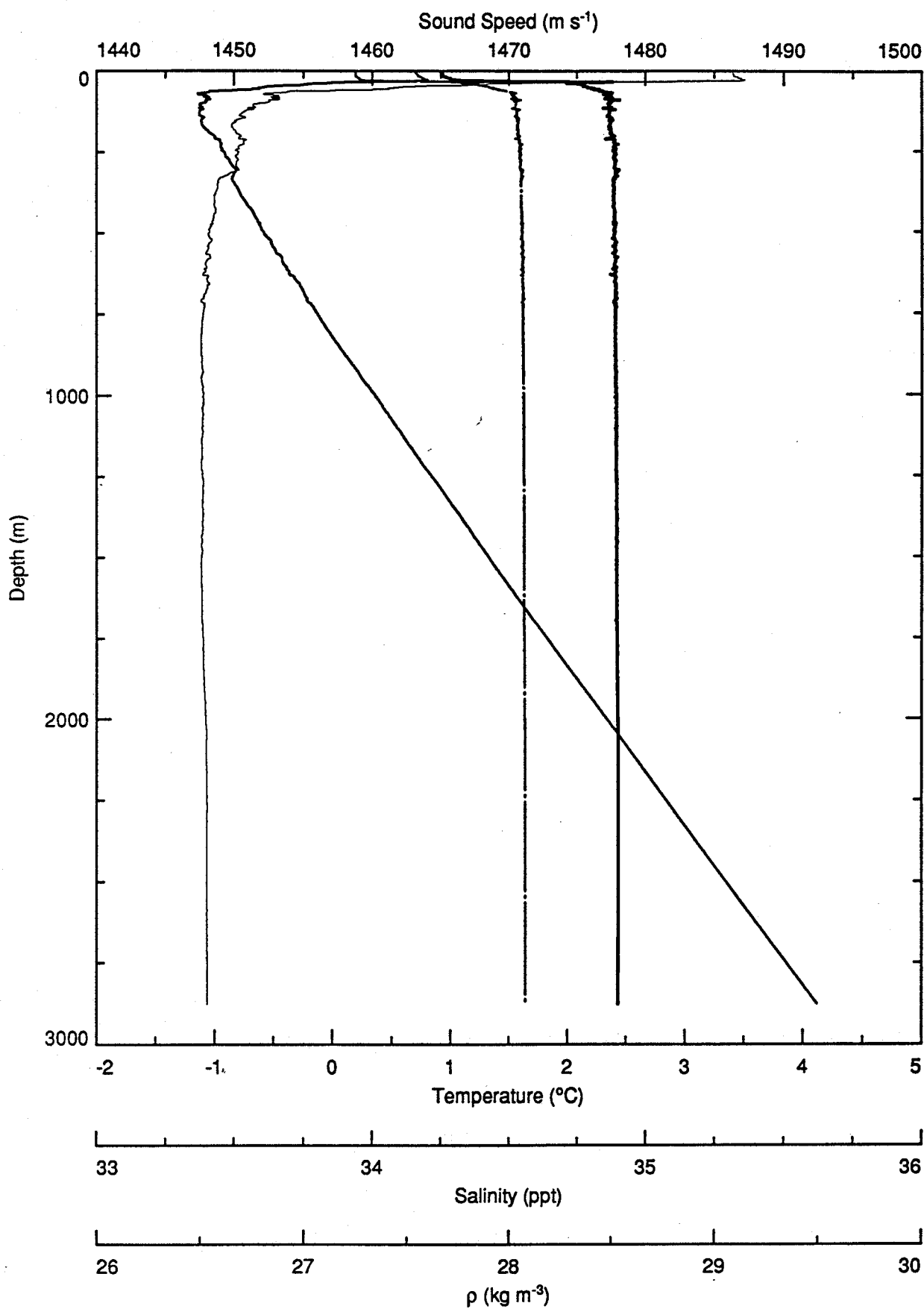
GSP Deployment CTD Cast 002



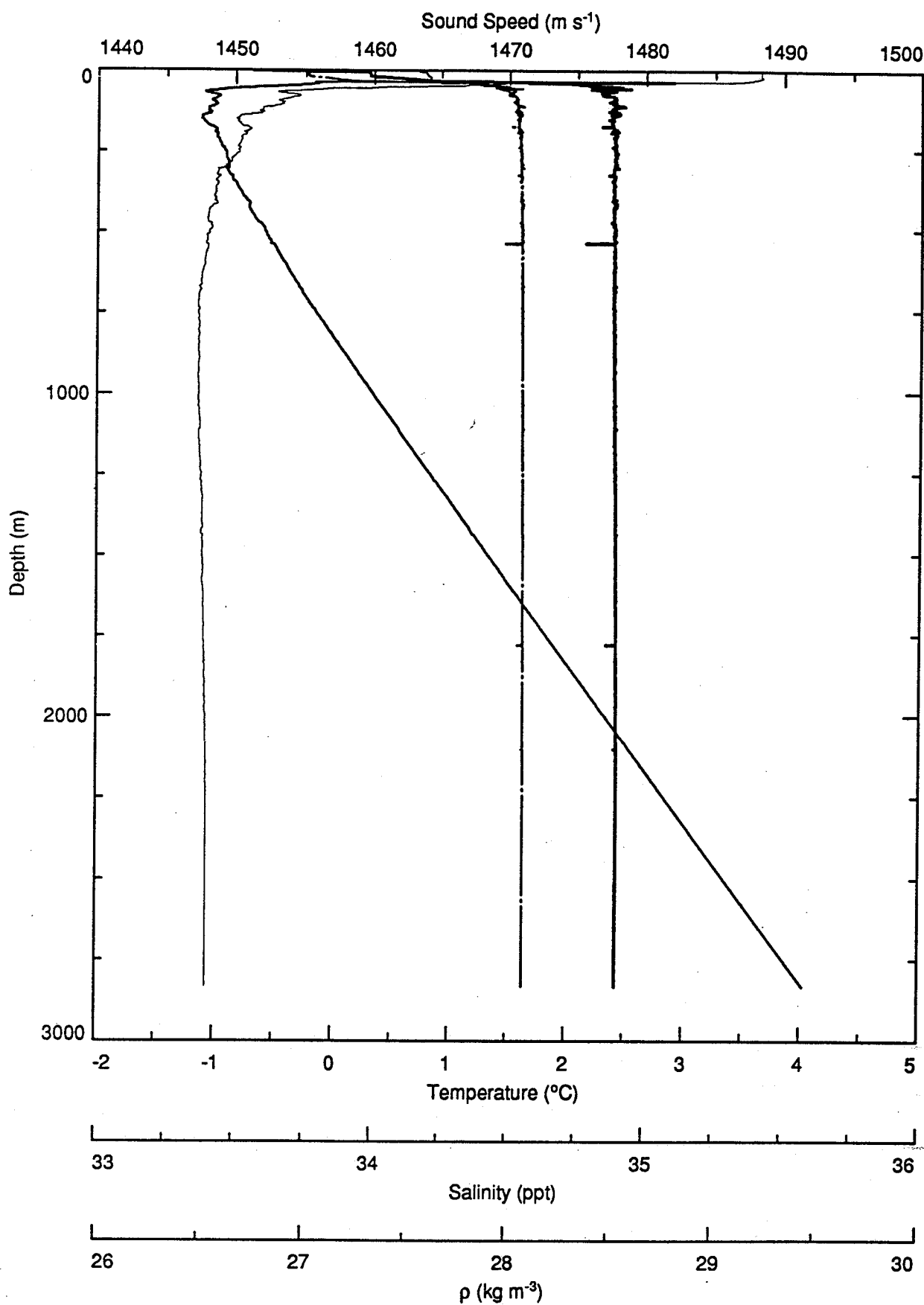
GSP Deployment CTD Cast 003



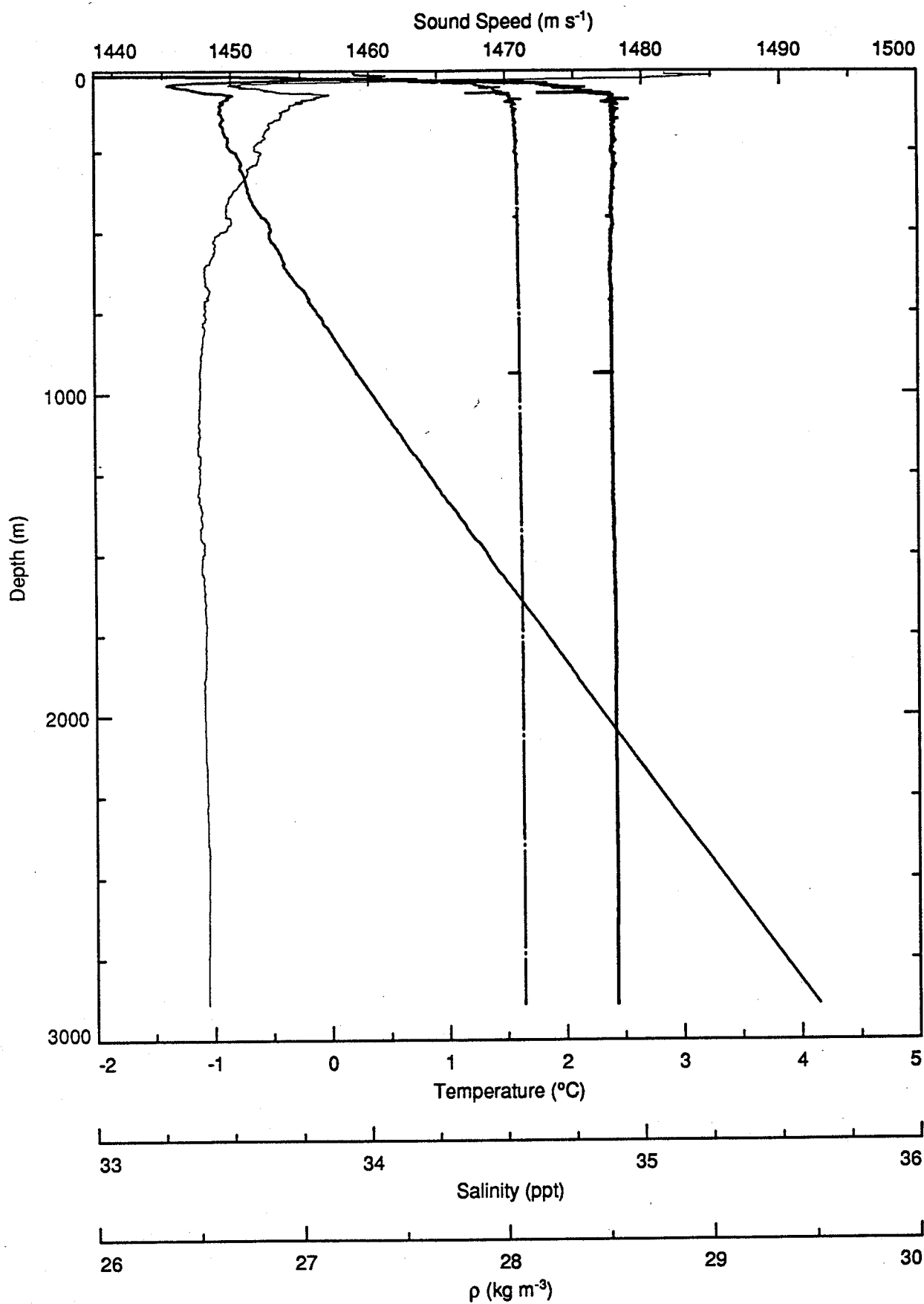
GSP Deployment CTD Cast 004



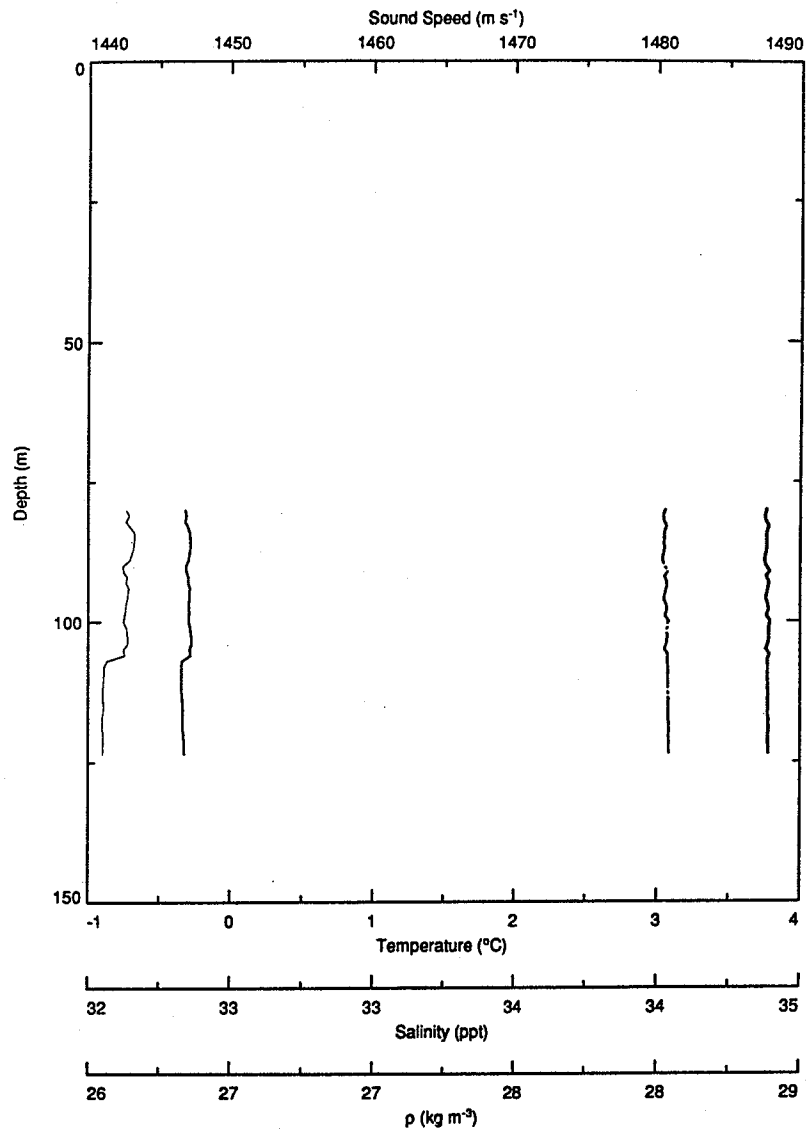
GSP Deployment CTD Cast 005



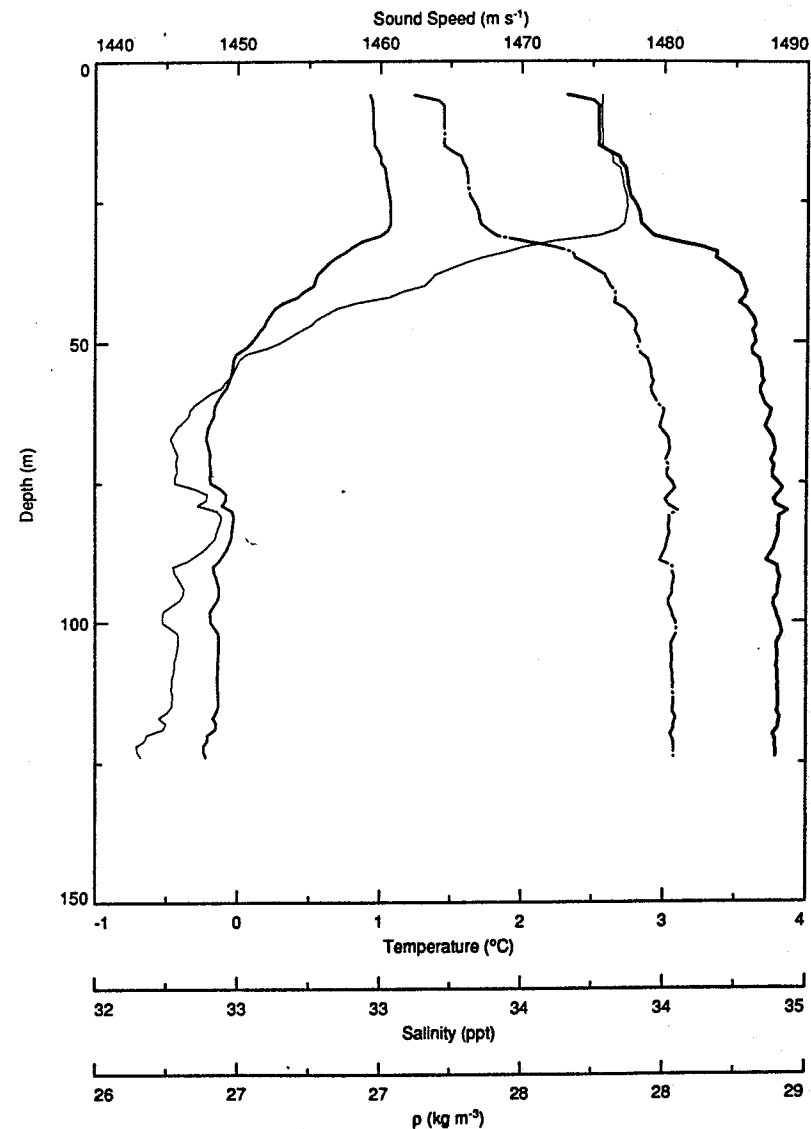
GSP Deployment CTD Cast 006



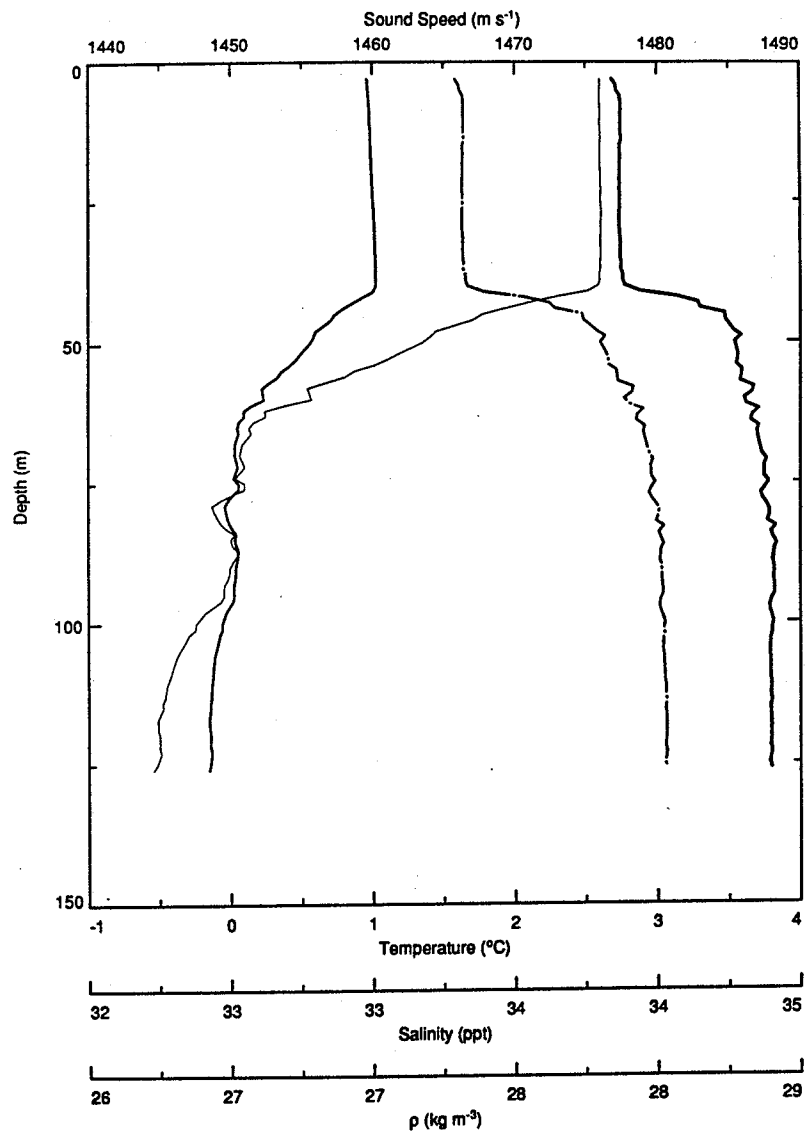
1988 MST : CTD Cast 001



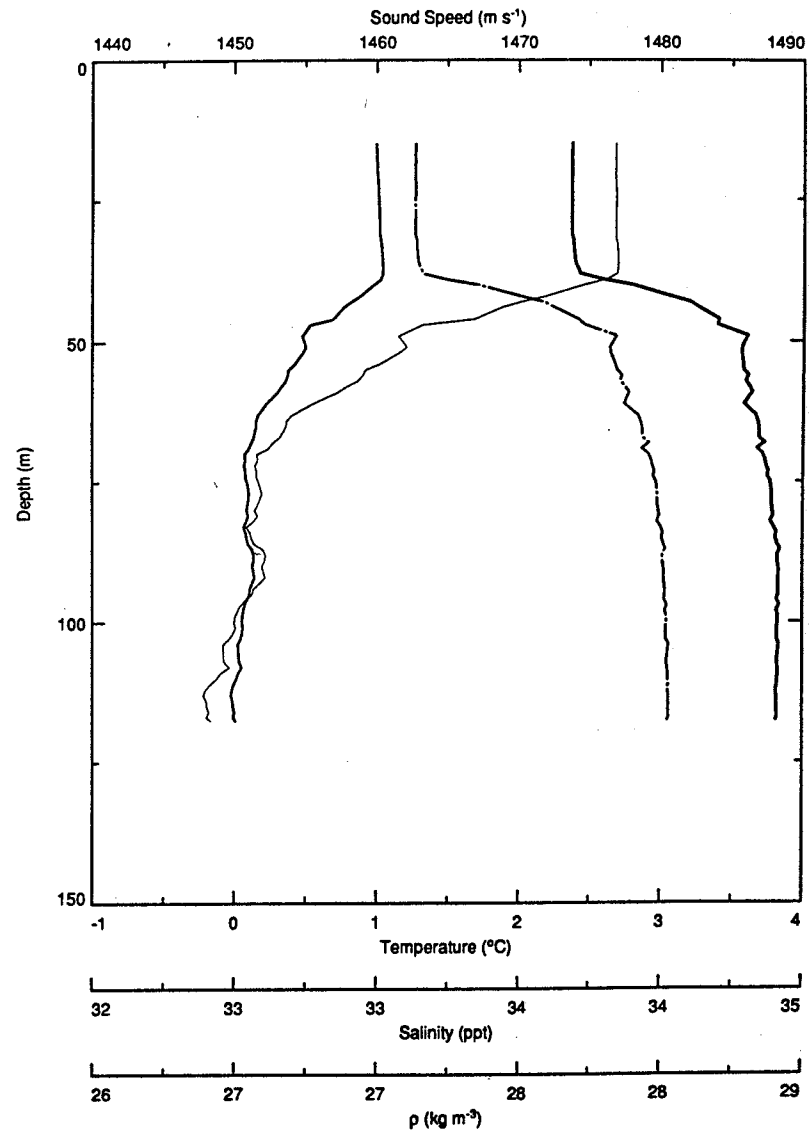
1988 MST : CTD Cast 002



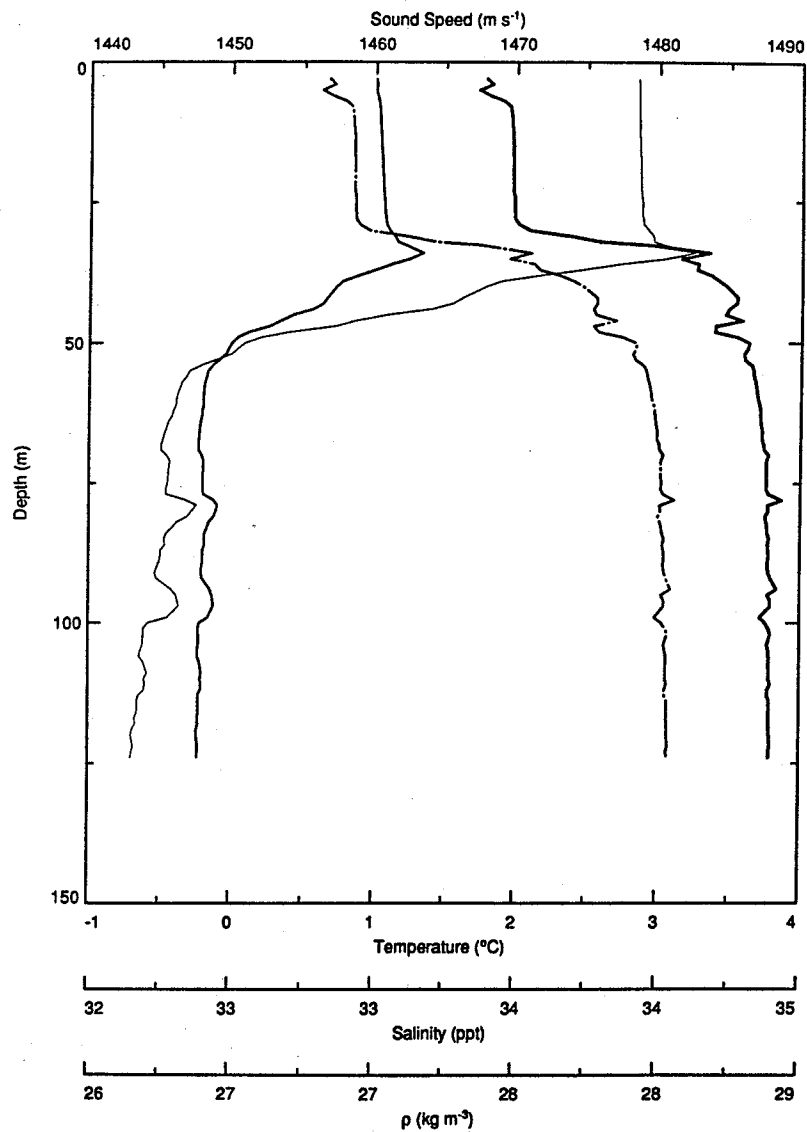
1988 MST : CTD Cast 003



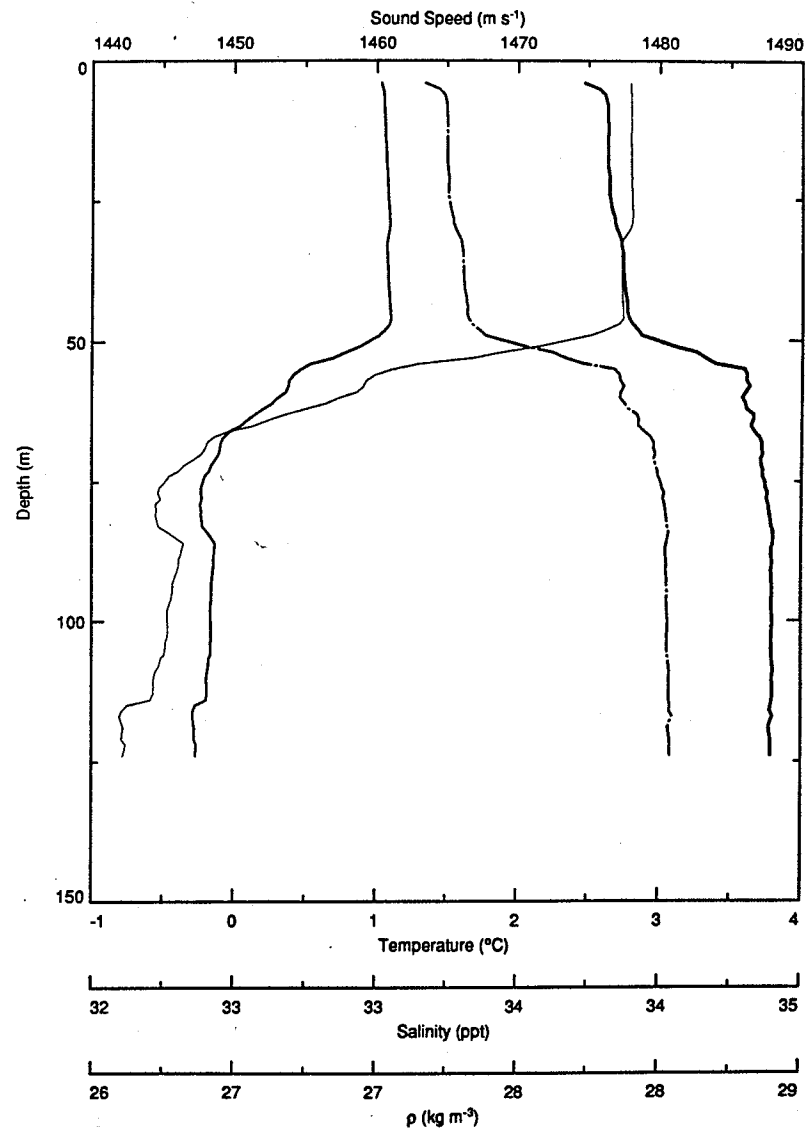
1988 MST : CTD Cast 004



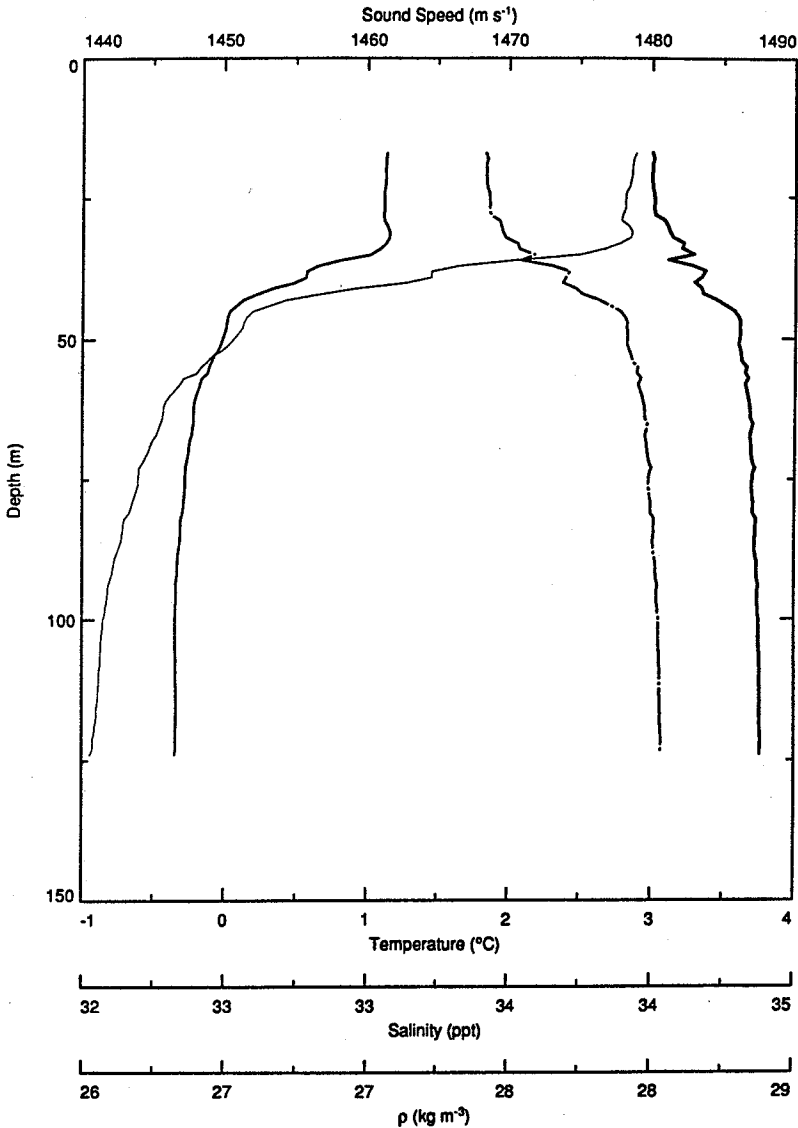
1988 MST : CTD Cast 005



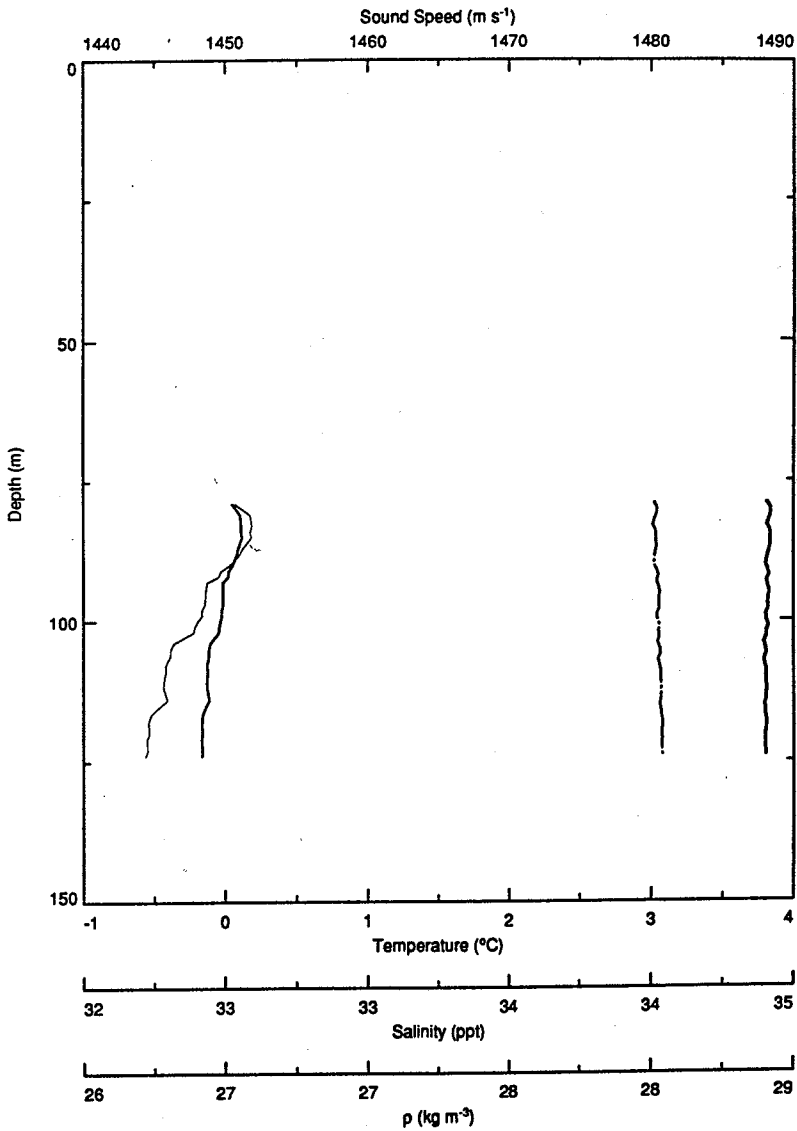
1988 MST : CTD Cast 008



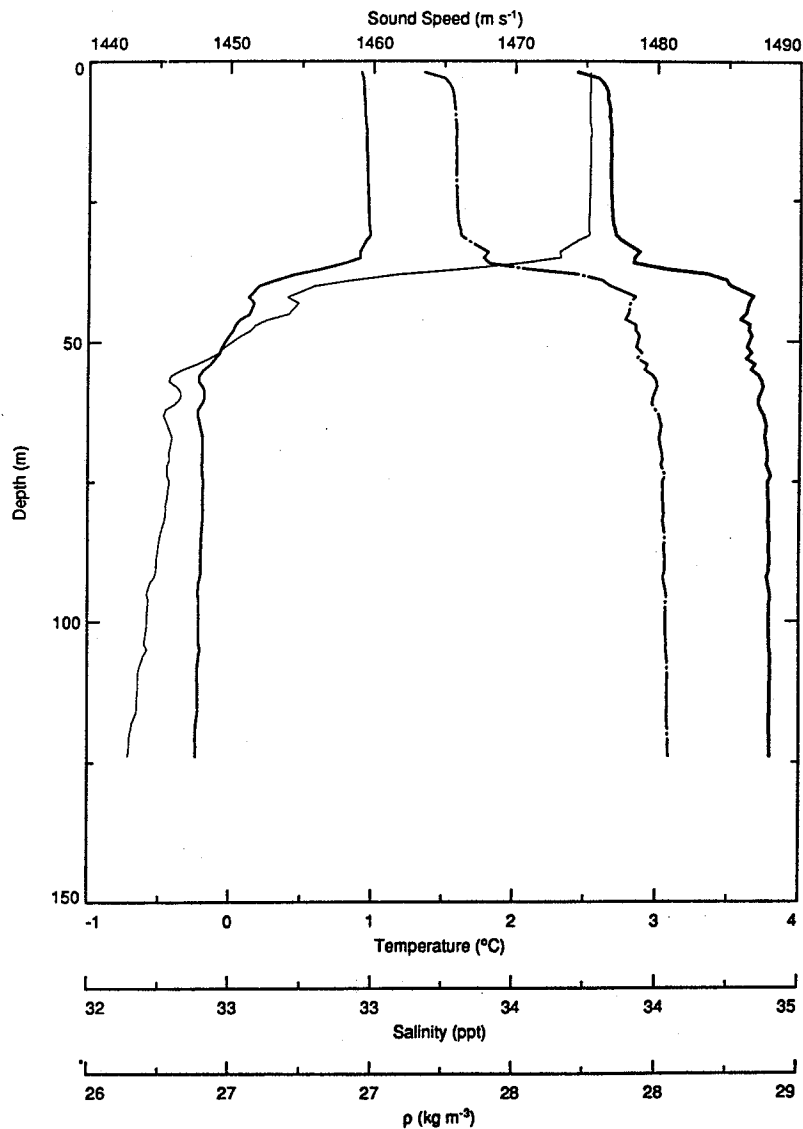
1988 MST : CTD Cast 009



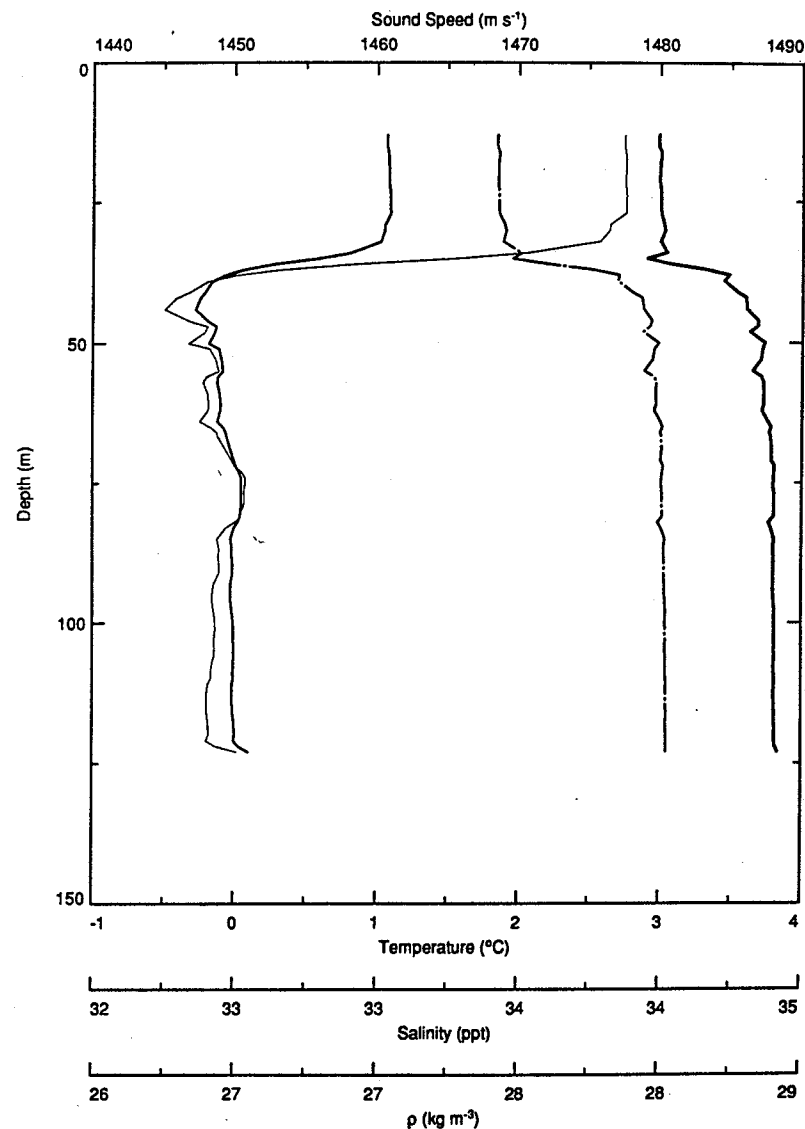
1988 MST : CTD Cast 010



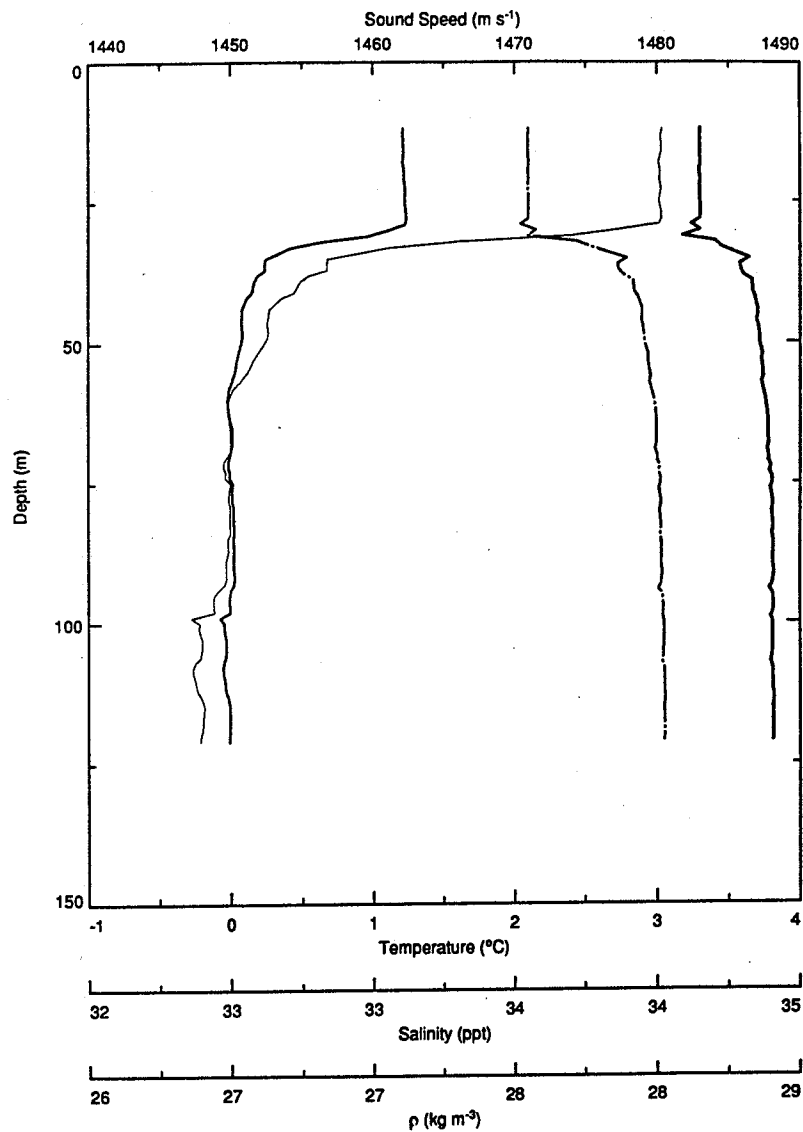
1988 MST : CTD Cast 011



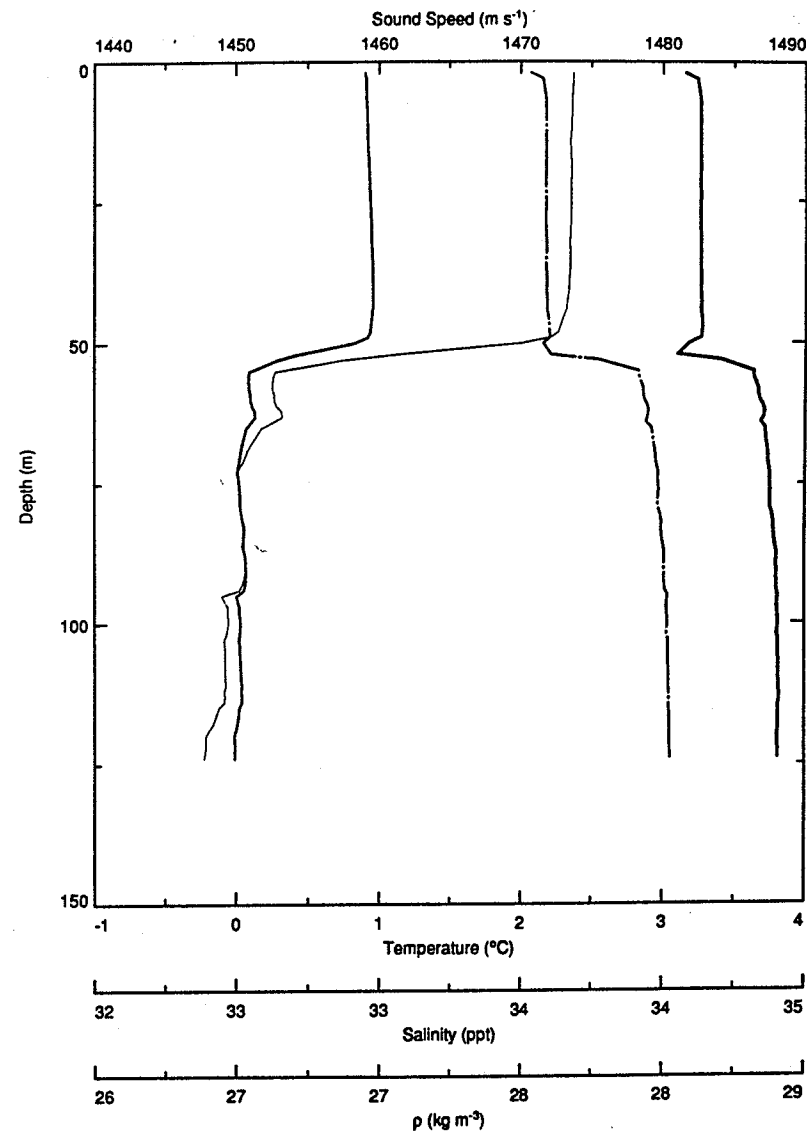
1988 MST : CTD Cast 012



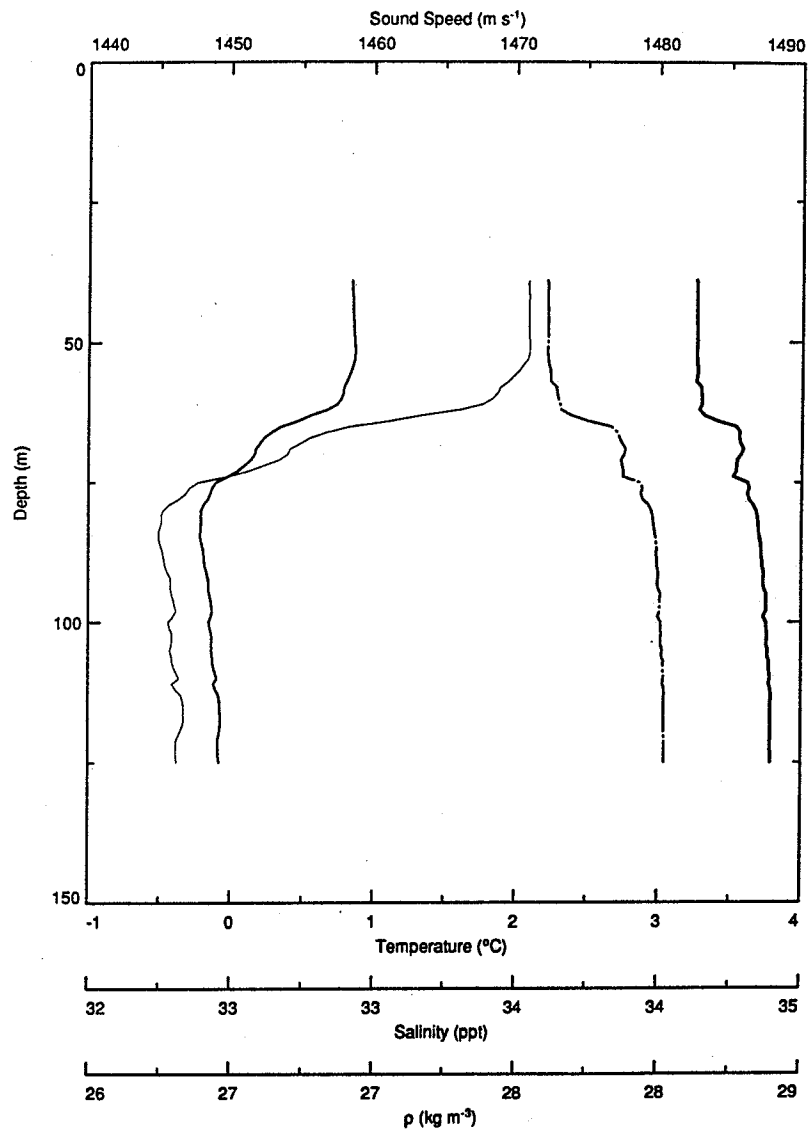
1988 MST : CTD Cast 013



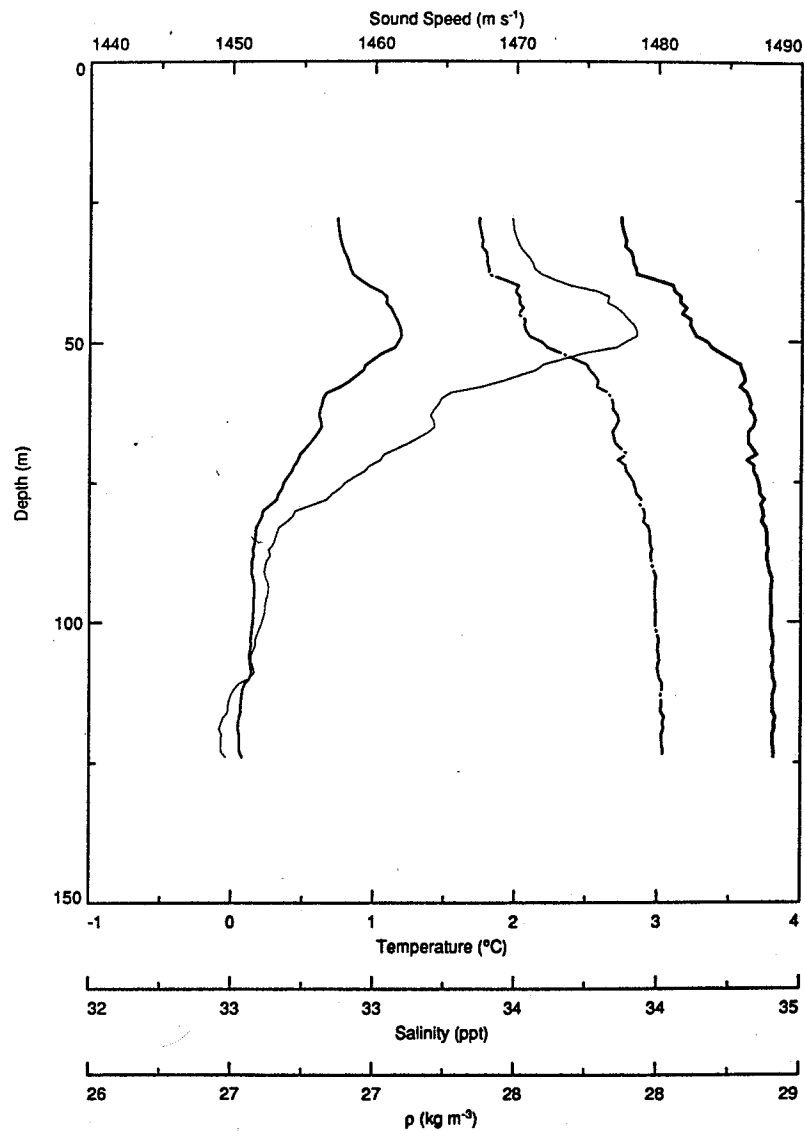
1988 MST : CTD Cast 014



1988 MST : CTD Cast 016

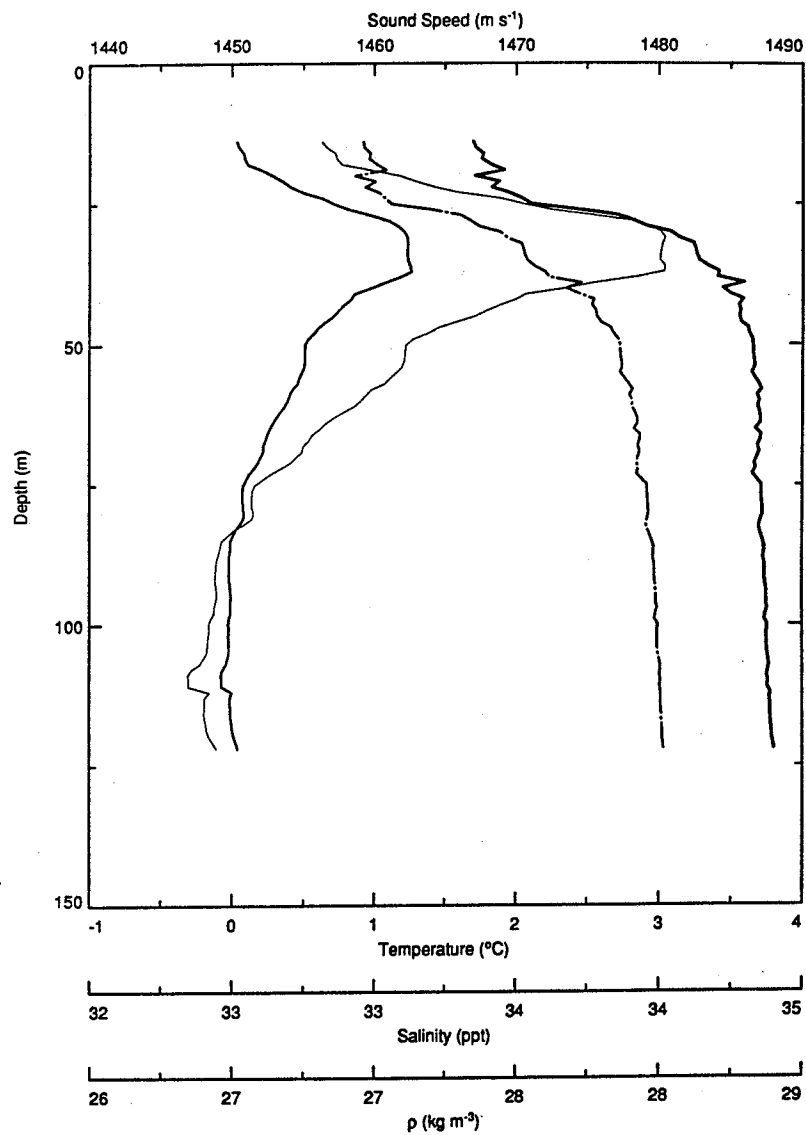


1988 MST : CTD Cast 018

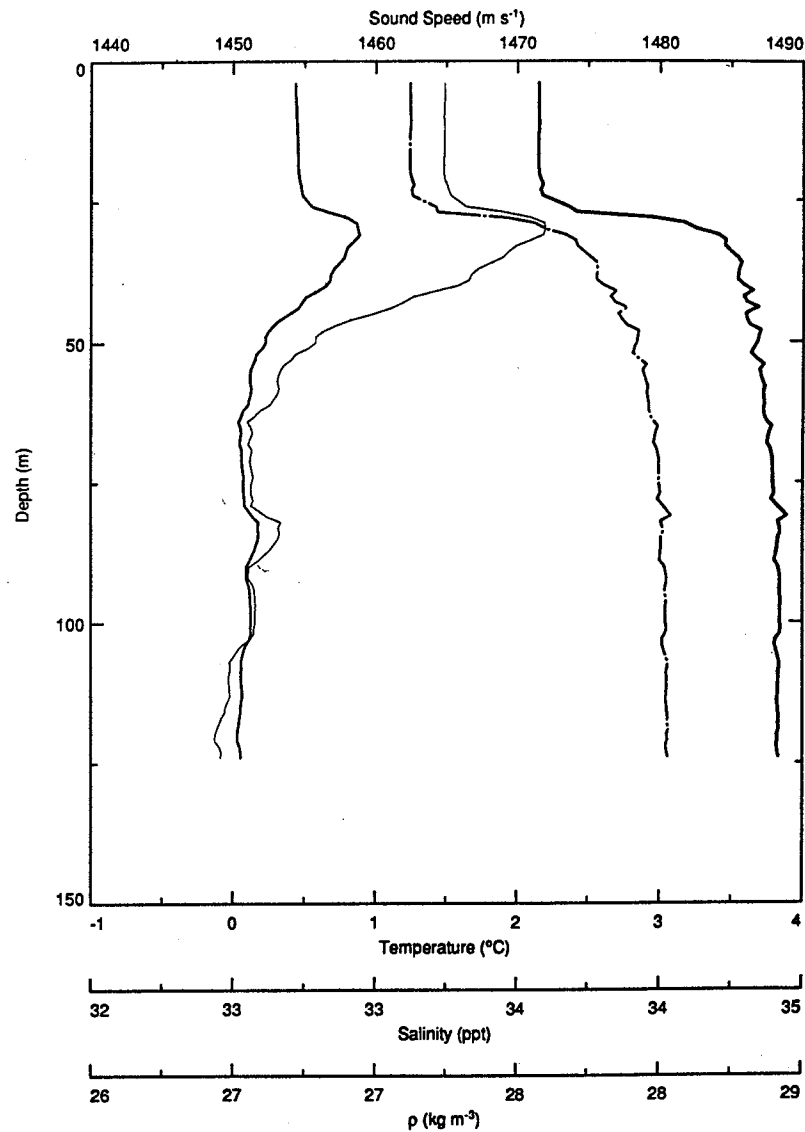


C14

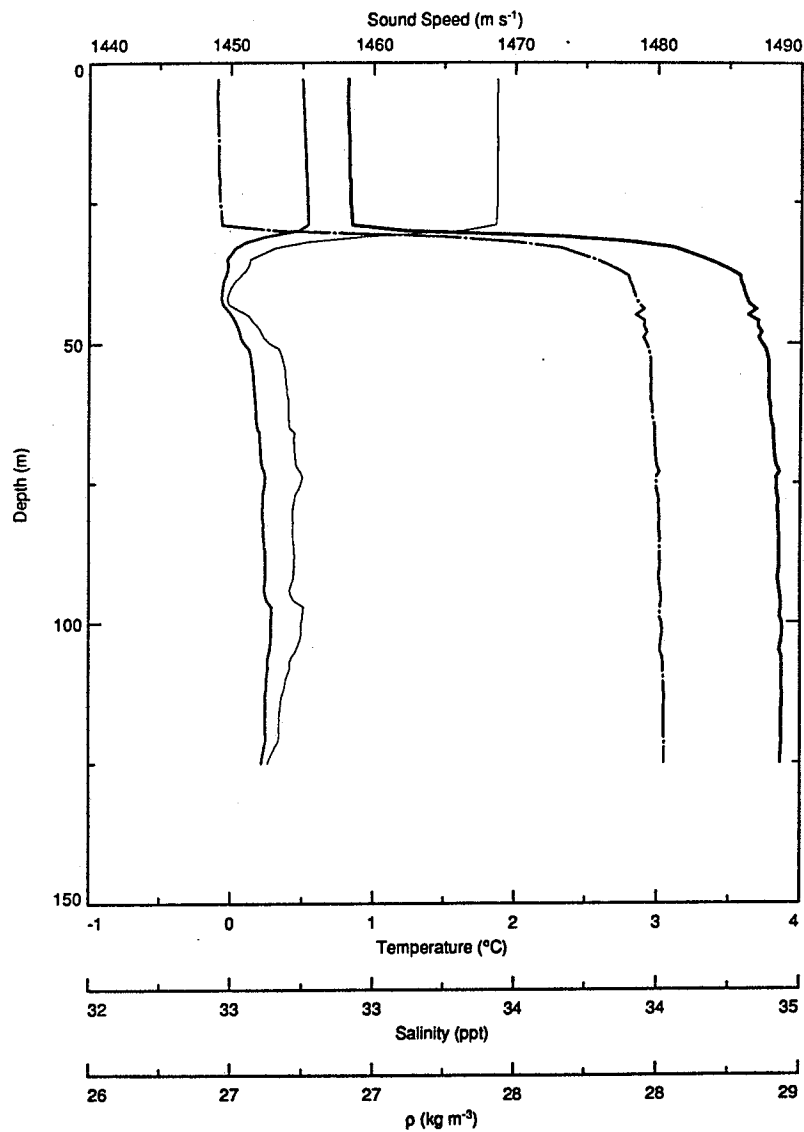
1988 MST : CTD Cast 019



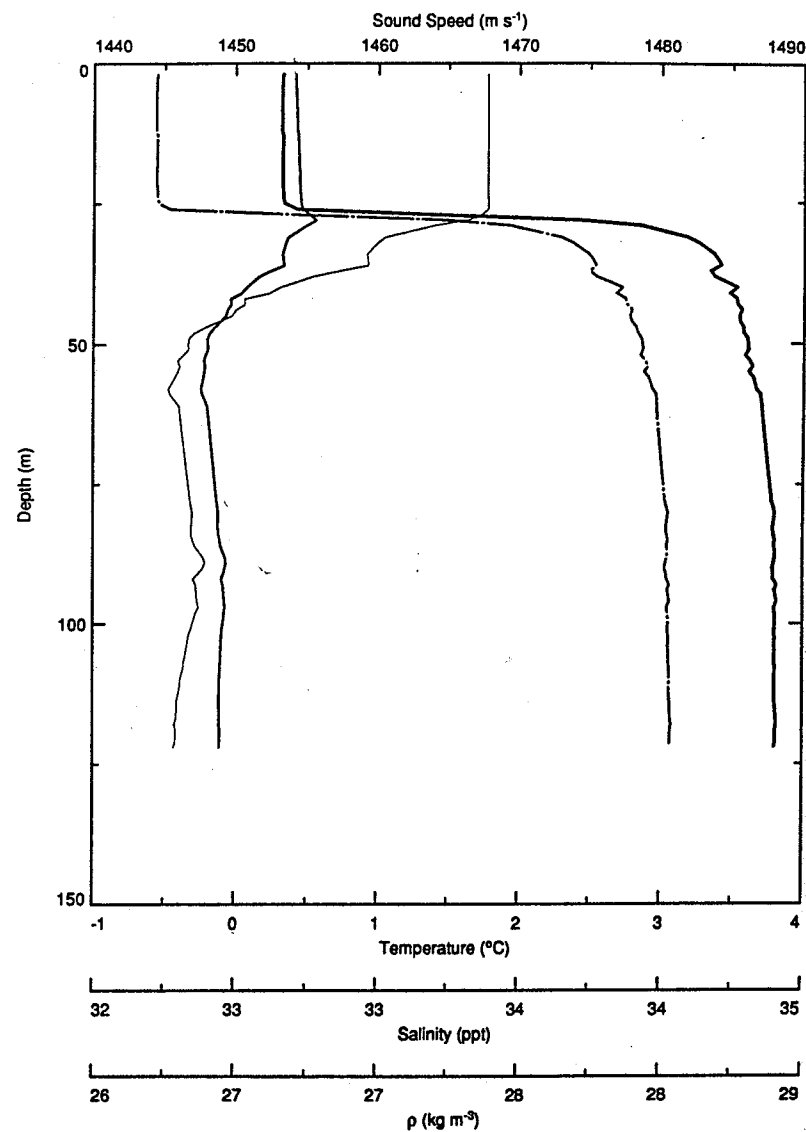
1988 MST : CTD Cast 022



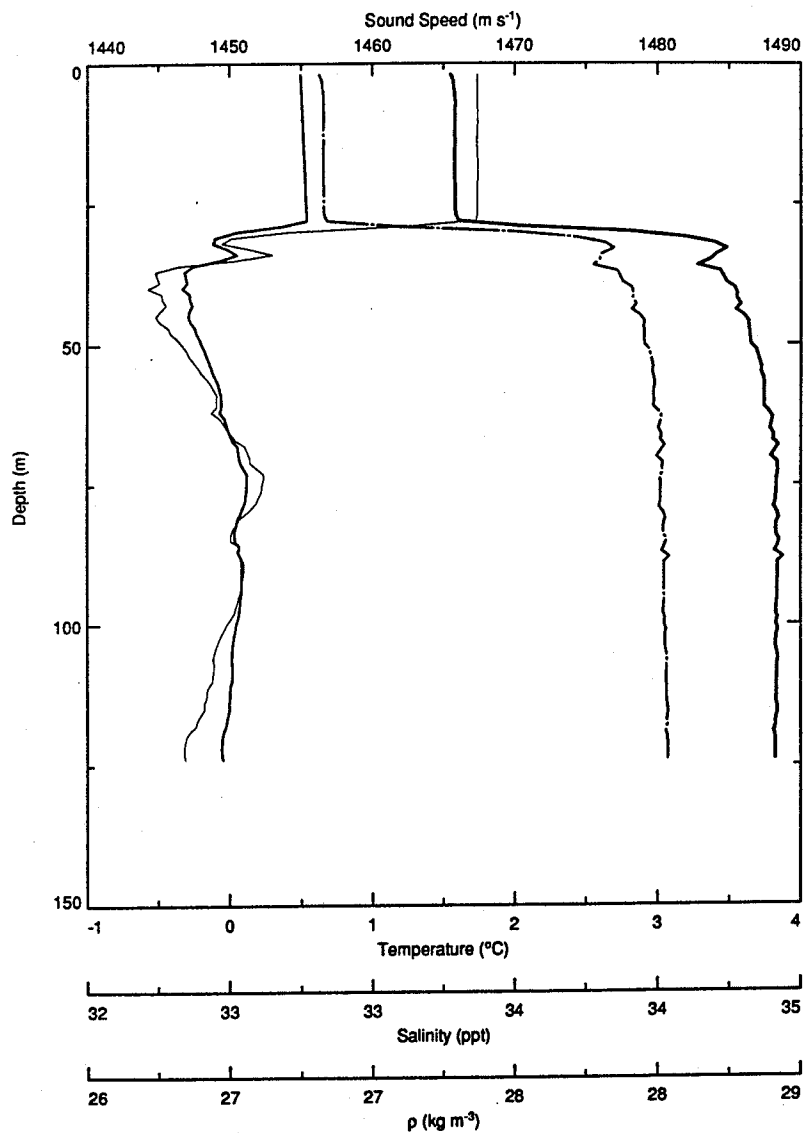
1988 MST : CTD Cast 023



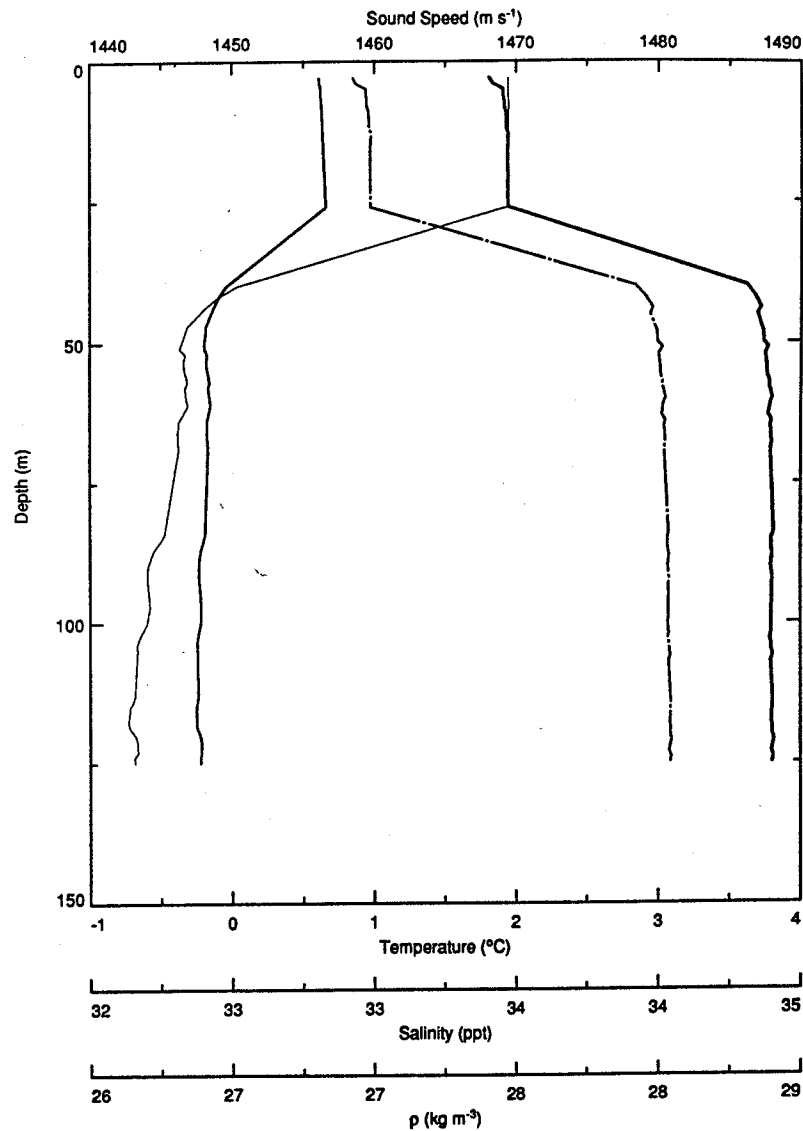
1988 MST : CTD Cast 024



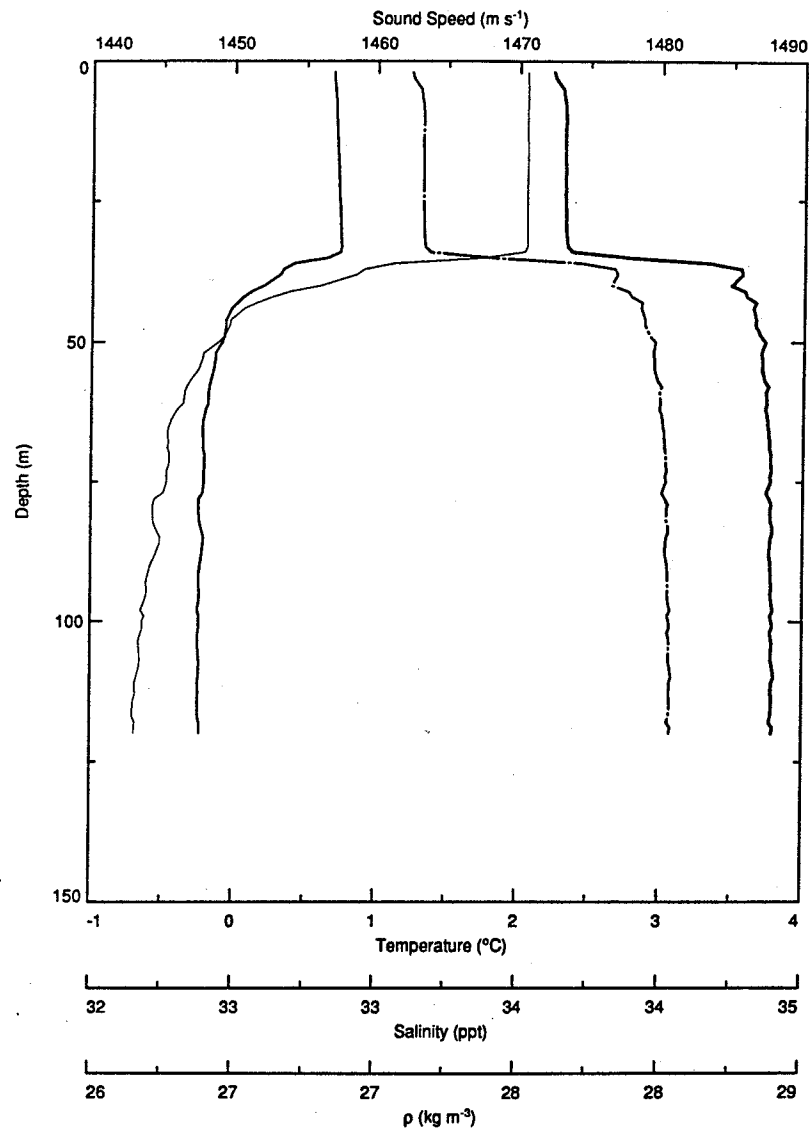
1988 MST : CTD Cast 026



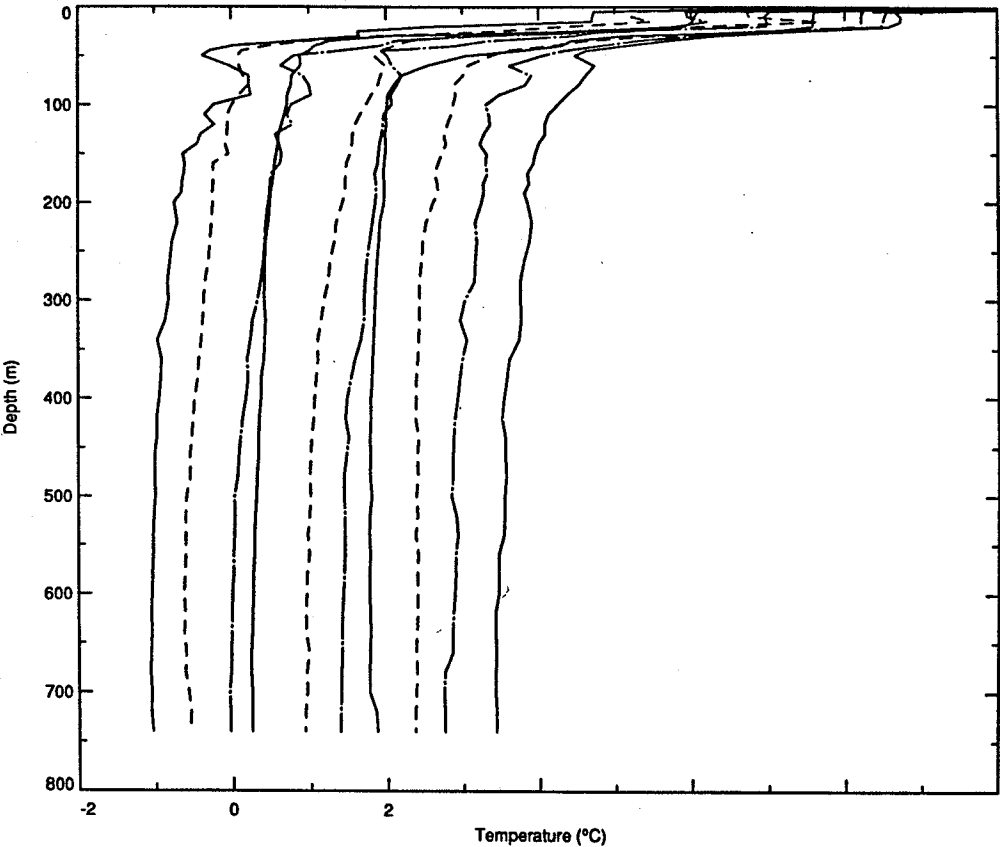
1988 MST : CTD Cast 027



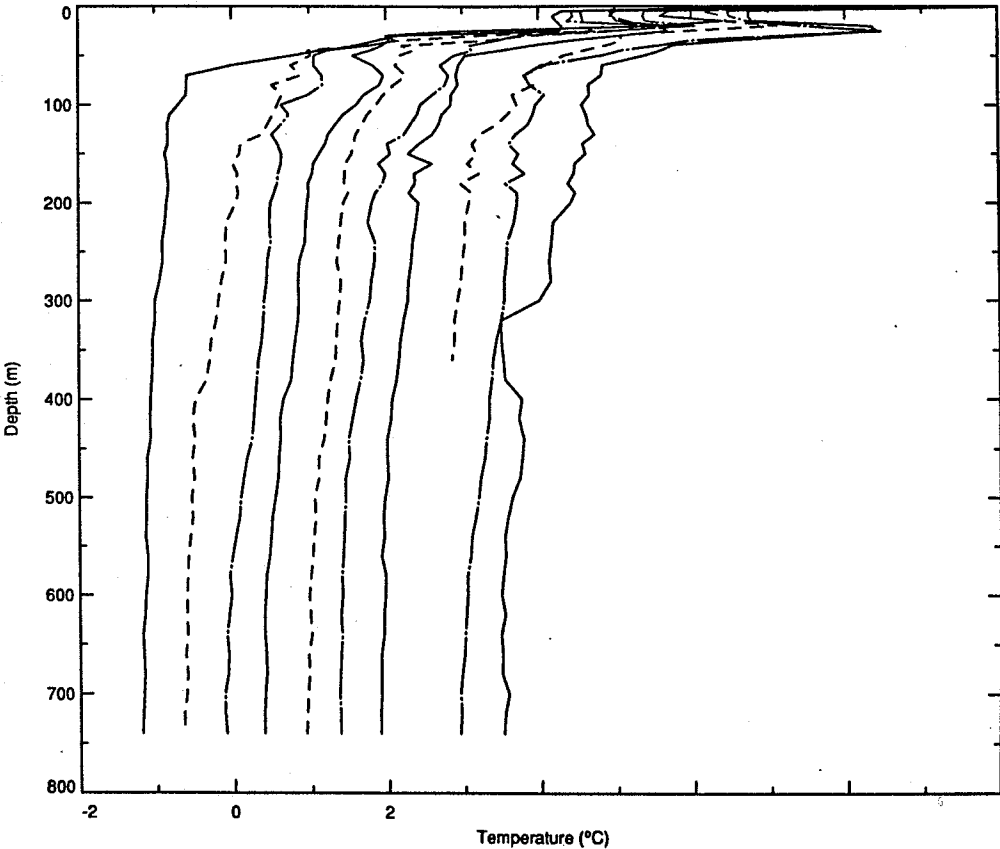
1988 MST : CTD Cast 028



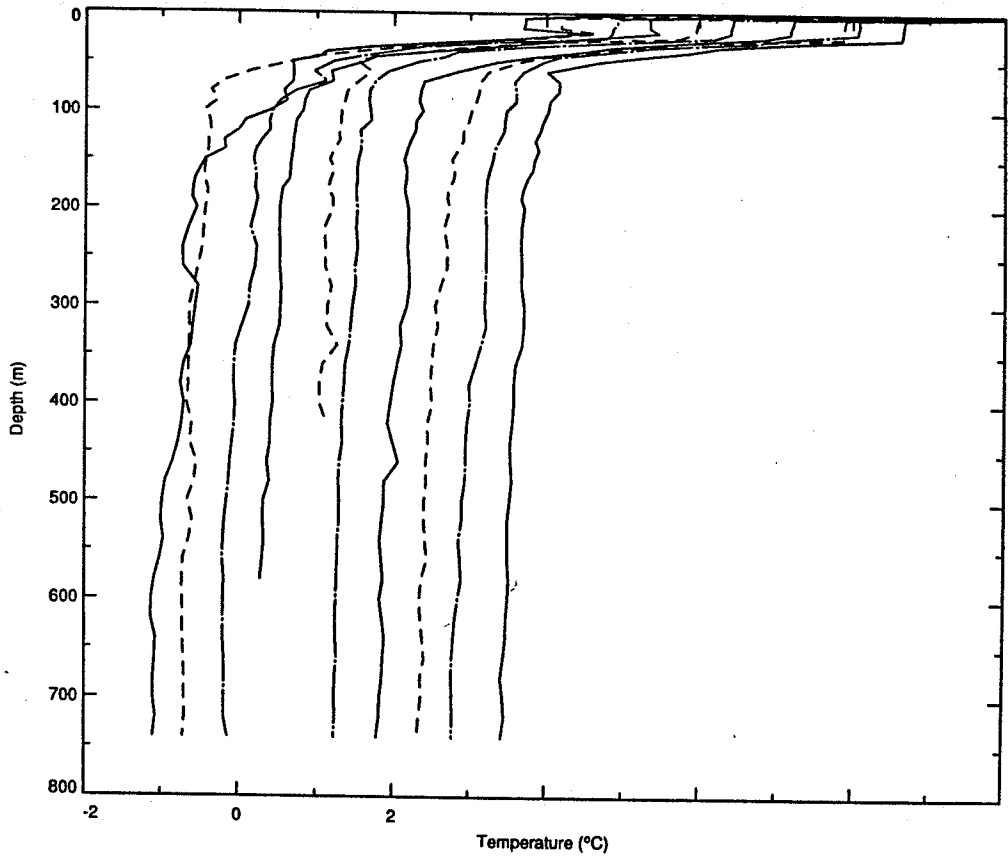
MST88 XBT Drops 1-10



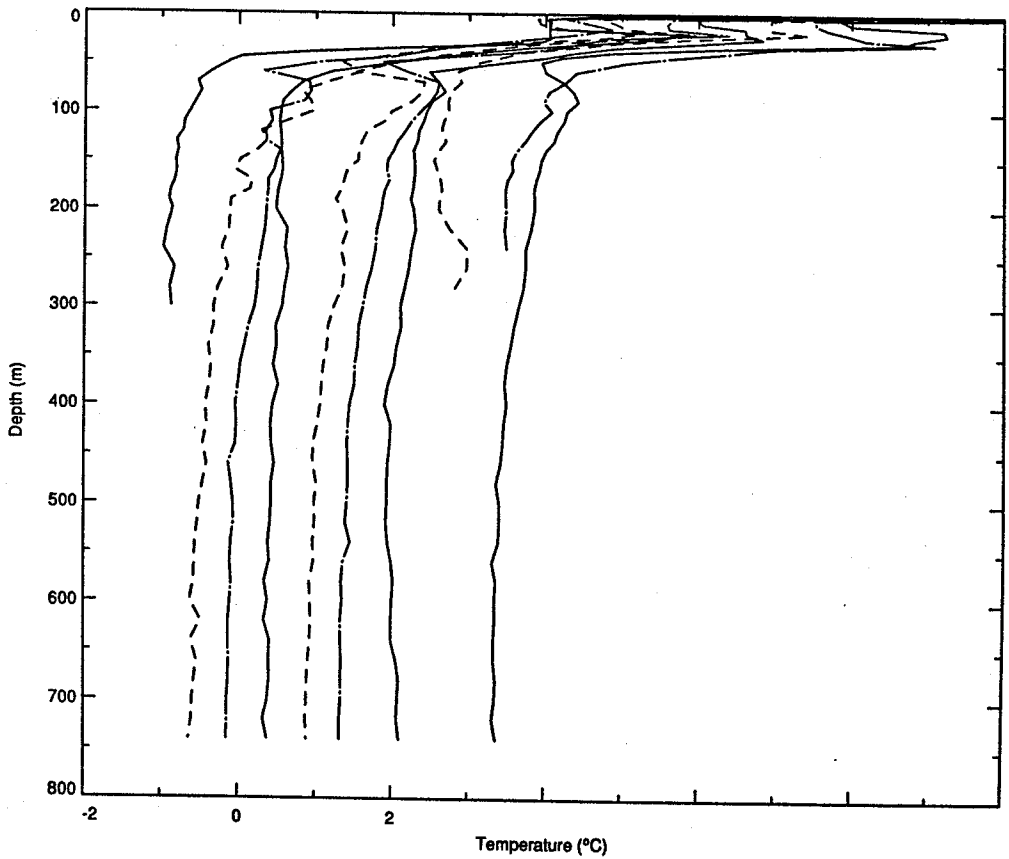
MST88 XBT Drops 11-20



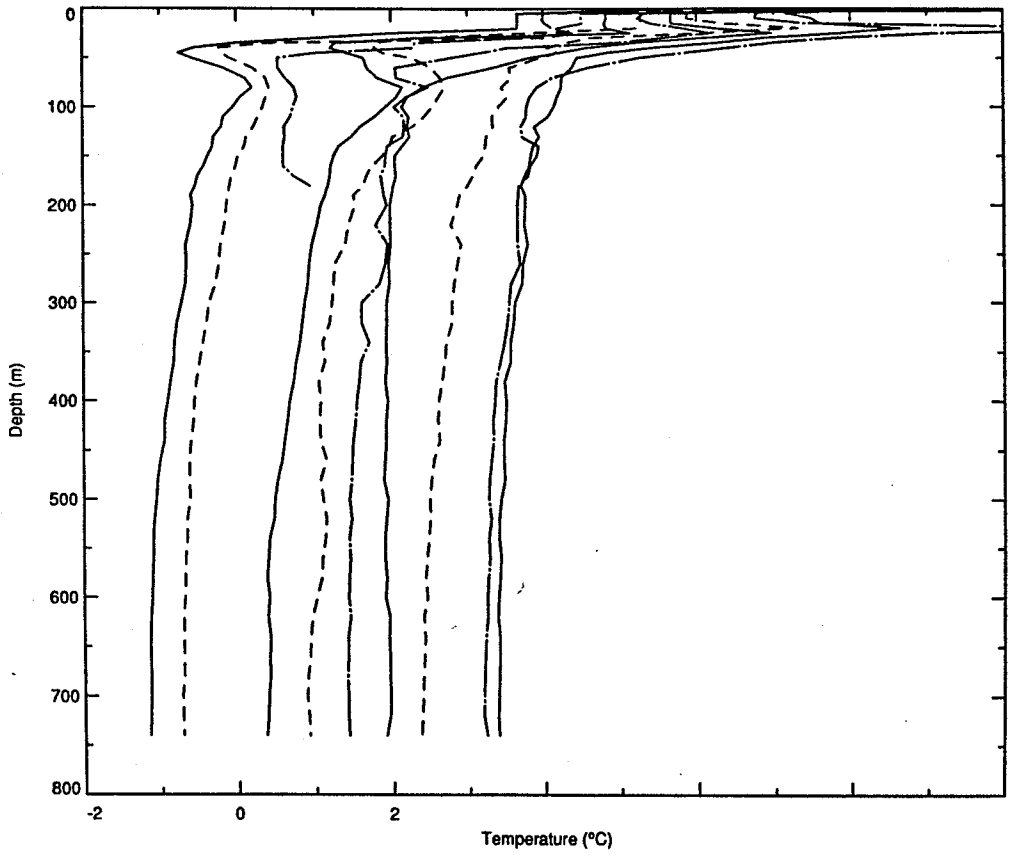
MST88 XBT Drops 21-30



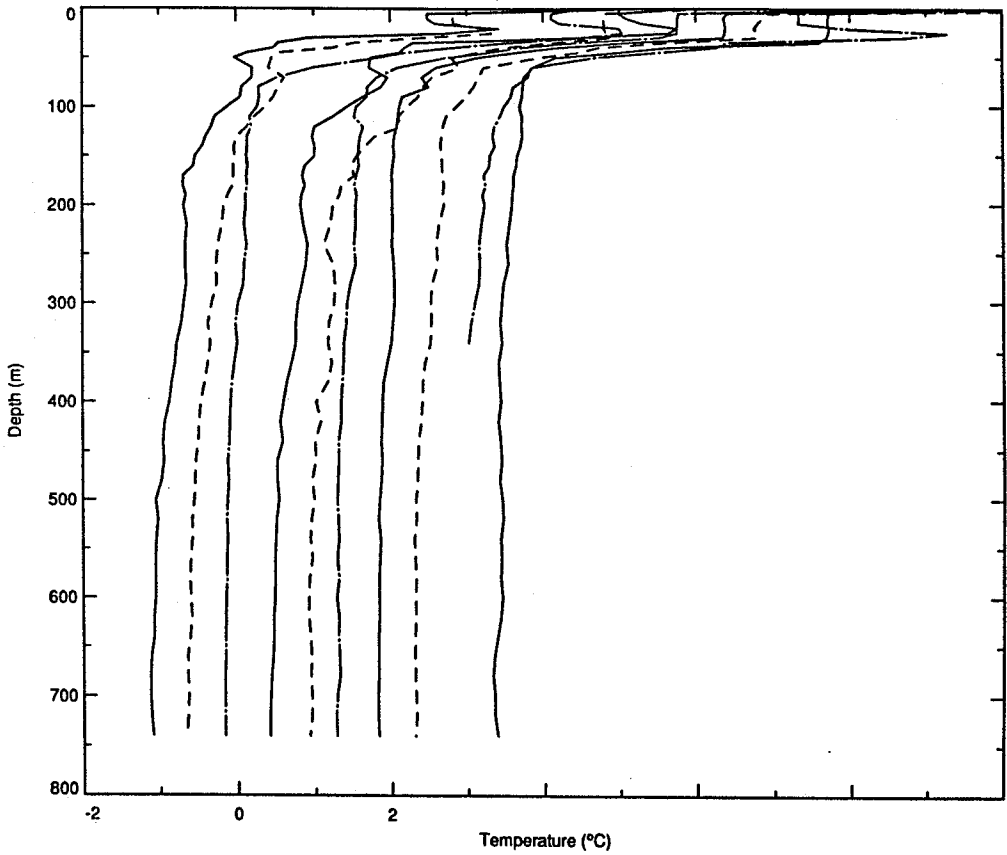
MST88 XBT Drops 31-40



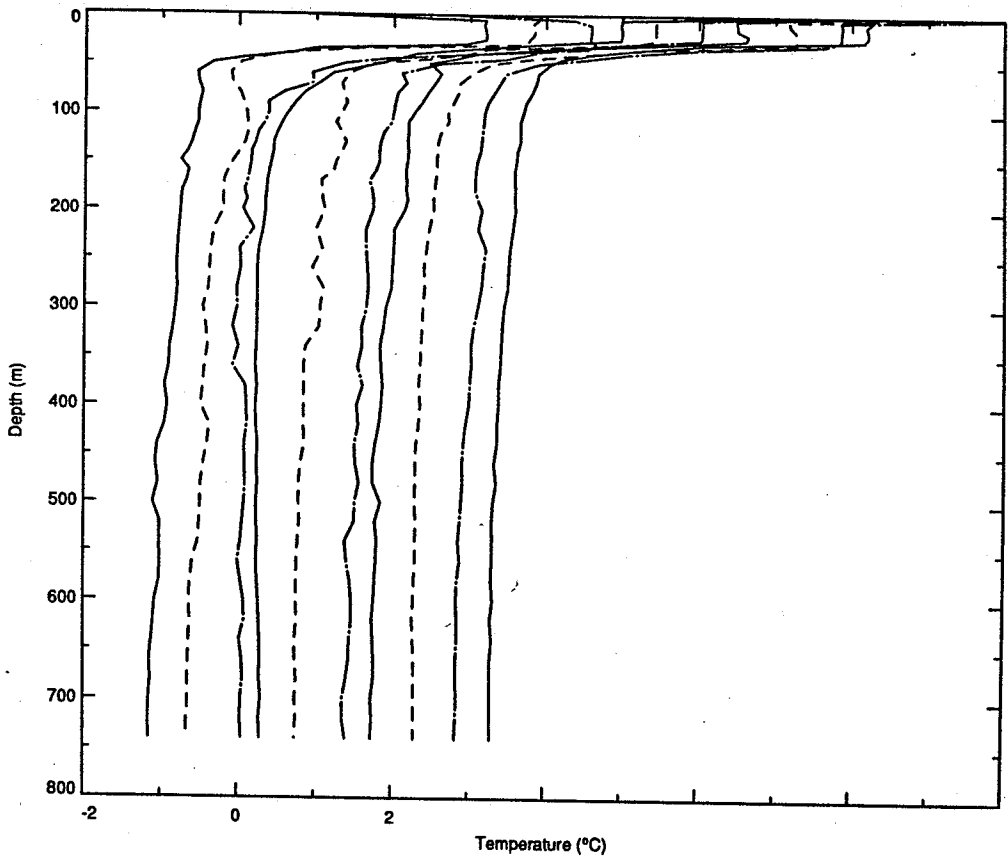
MST88 XBT Drops 41-50



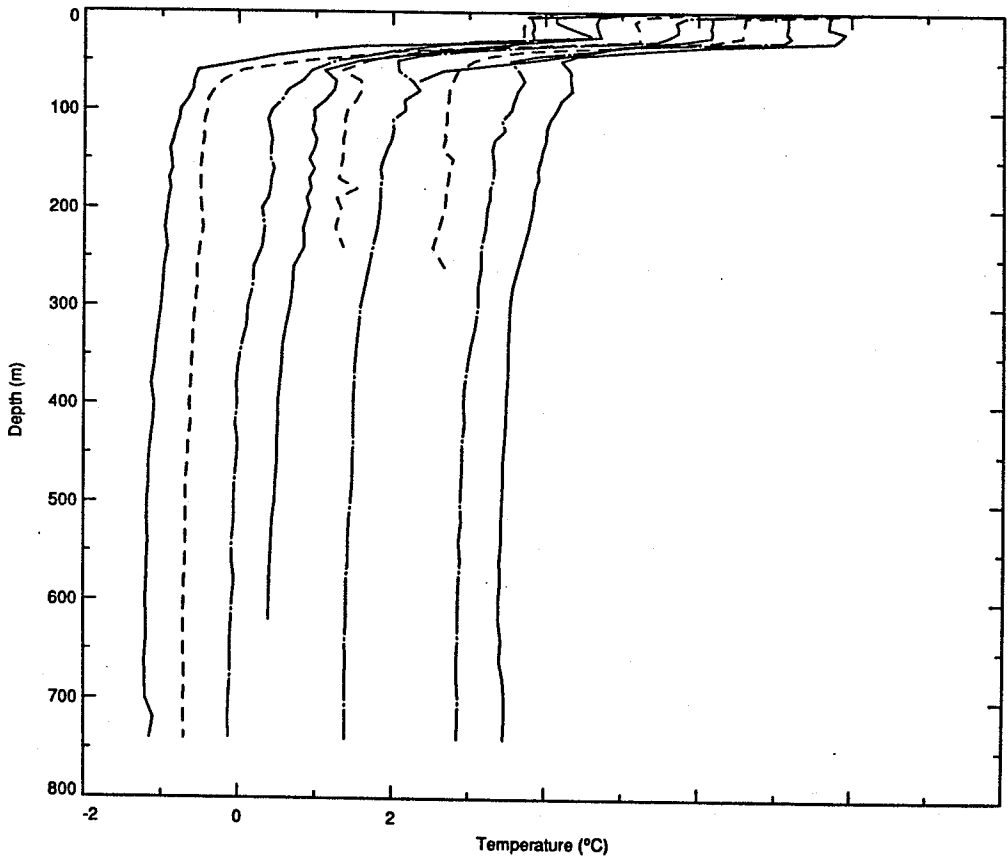
MST88 XBT Drops 51-60



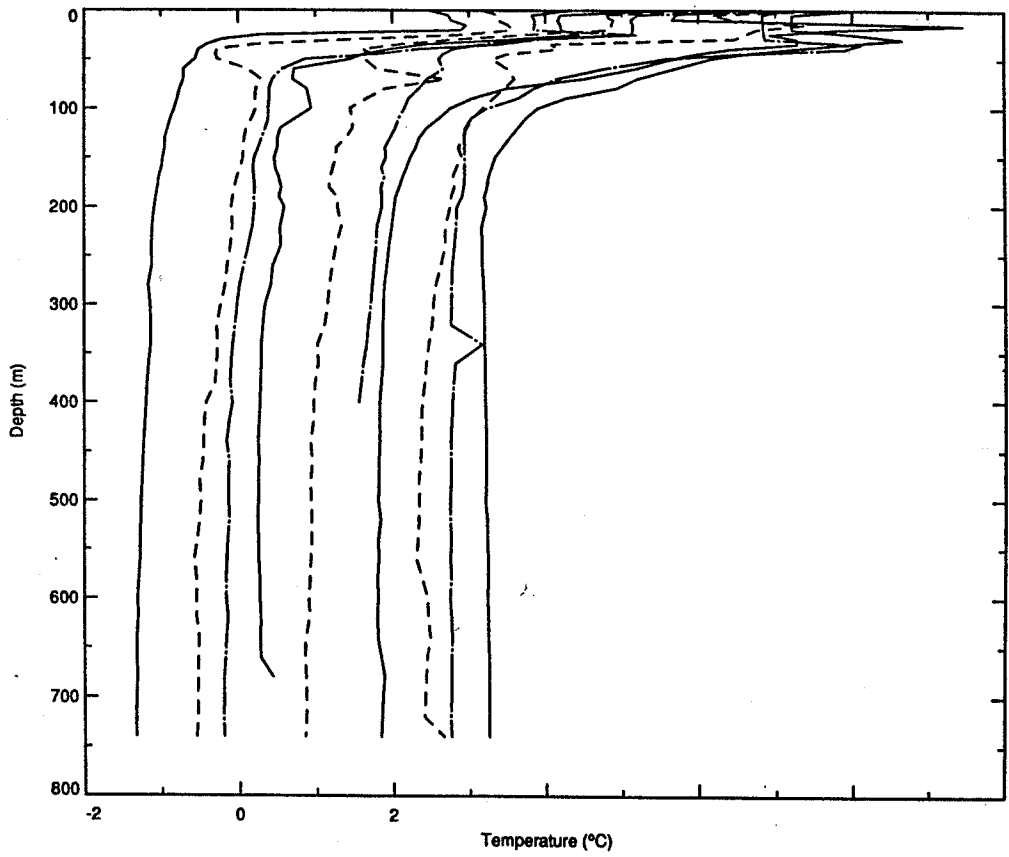
MST88 XBT Drops 61-70



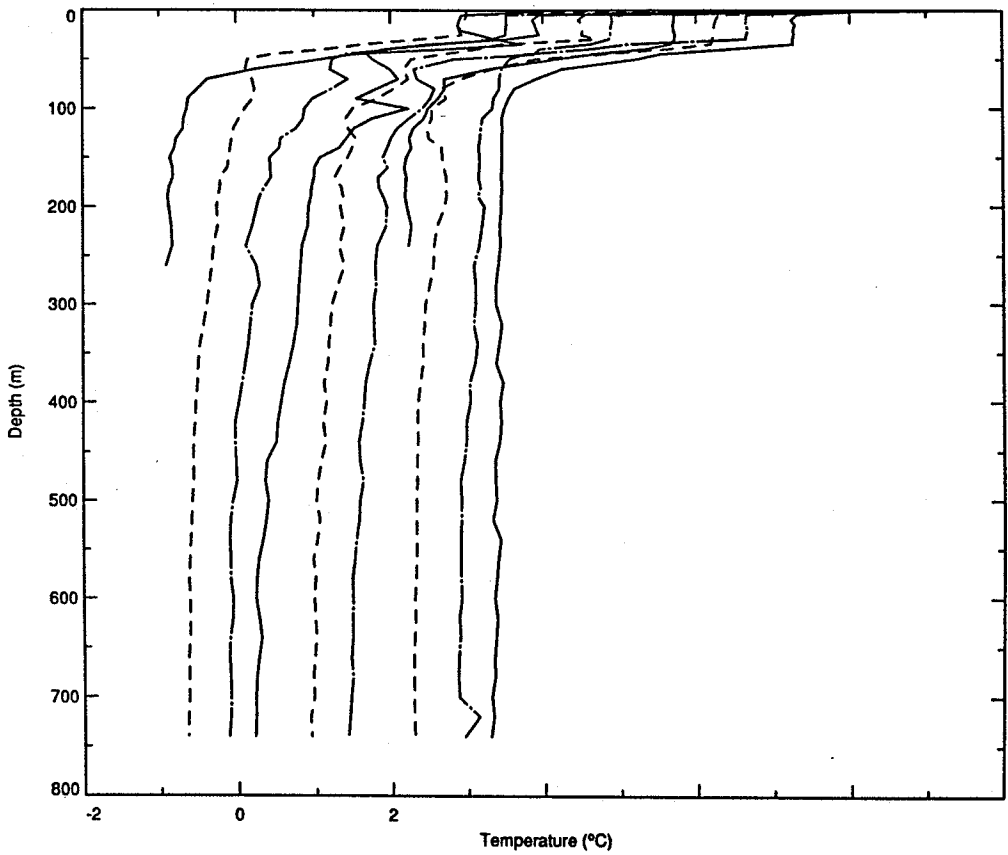
MST88 XBT Drops 71-80



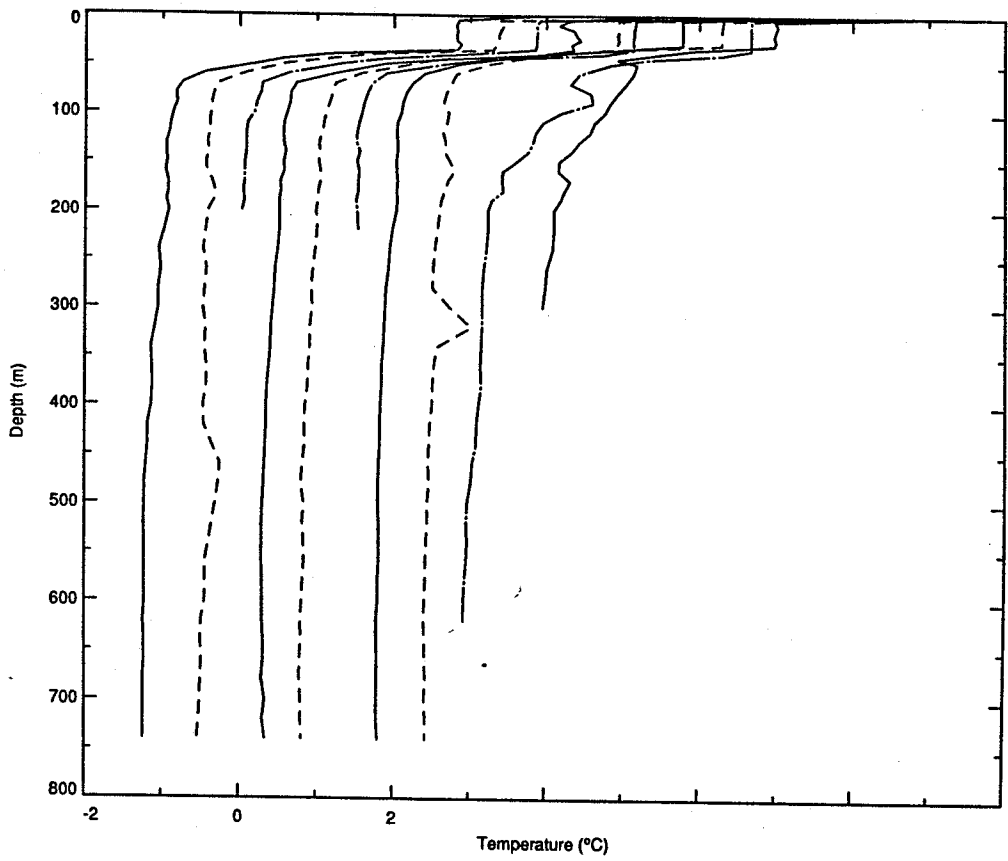
MST88 XBT Drops 81-90



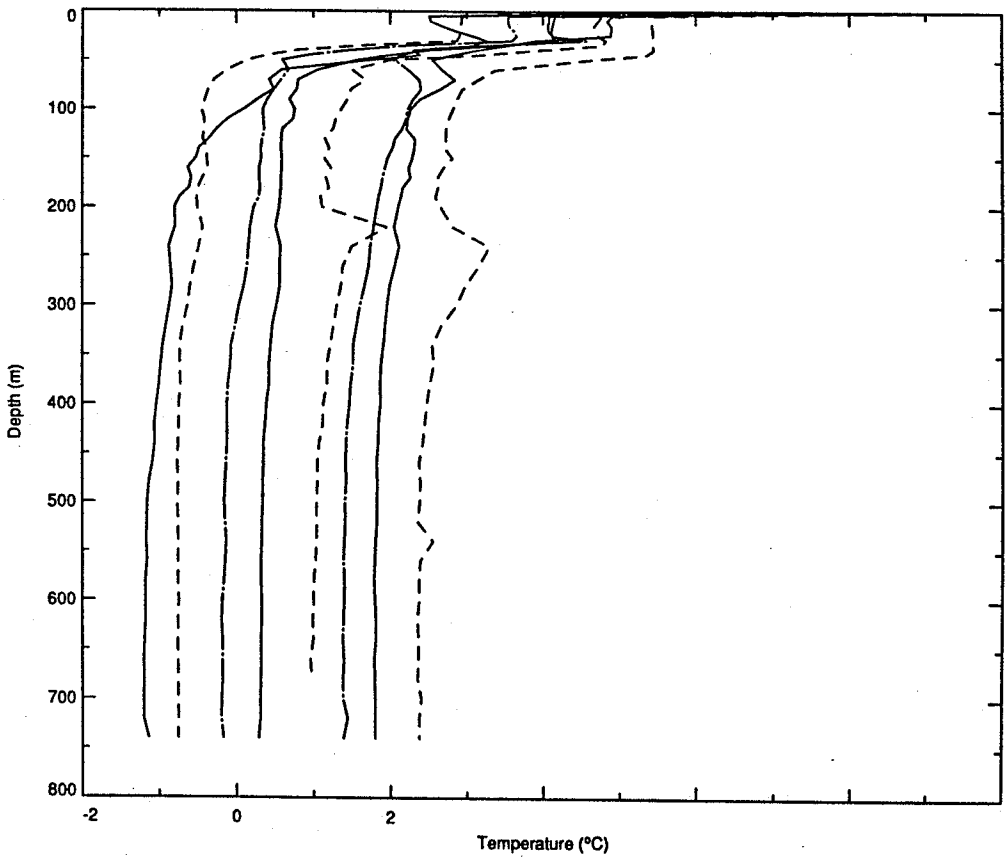
MST88 XBT Drops 91-100



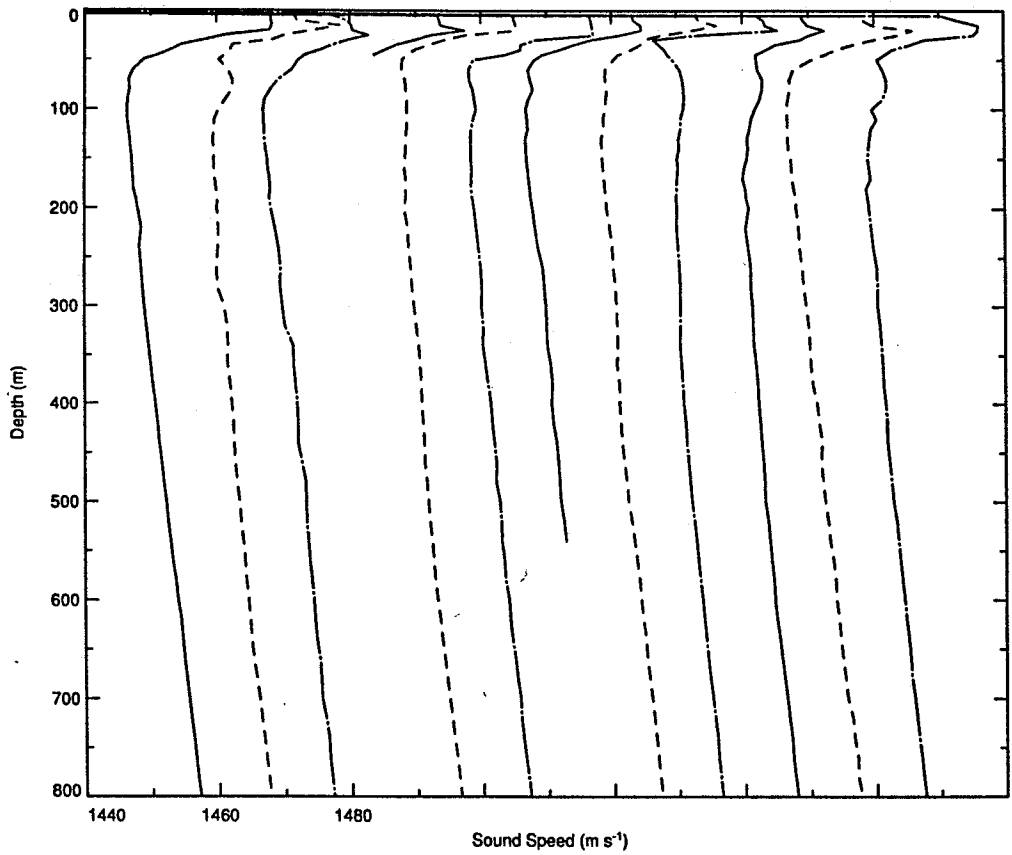
MST88 XBT Drops 101-110



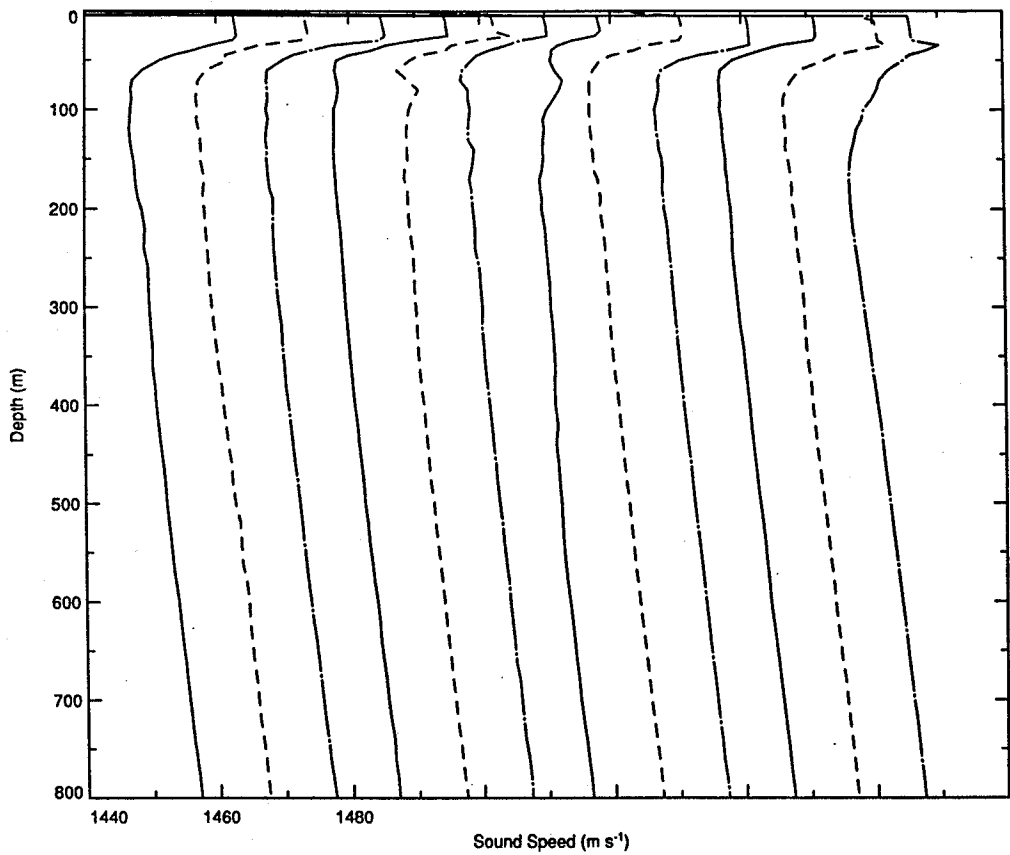
MST88 XBT Drops 111-118



MST88 XSV Drops 1-12



MST88 XSV Drops 13-24



APPENDIX D

Plots of Raw Profile Data for the 1989 Cruise

The plots of the raw profile data presented in this appendix are ordered as follows:

Deep CTD casts (labeled GSP Deployment CTD cast #,
where # is the cast number given in the log)

Shallow CTD casts (labeled 1989 MST: CTD cast #)

Waterfall plots of XBT profiles (labeled MST 89 XBT Drops #—#)

Waterfall plots of XSV profiles (labeled MST89 XSV Drops #—#).

For the CTD plots, the key is as follows:

Temperature = thin line

Salinity = heavy line

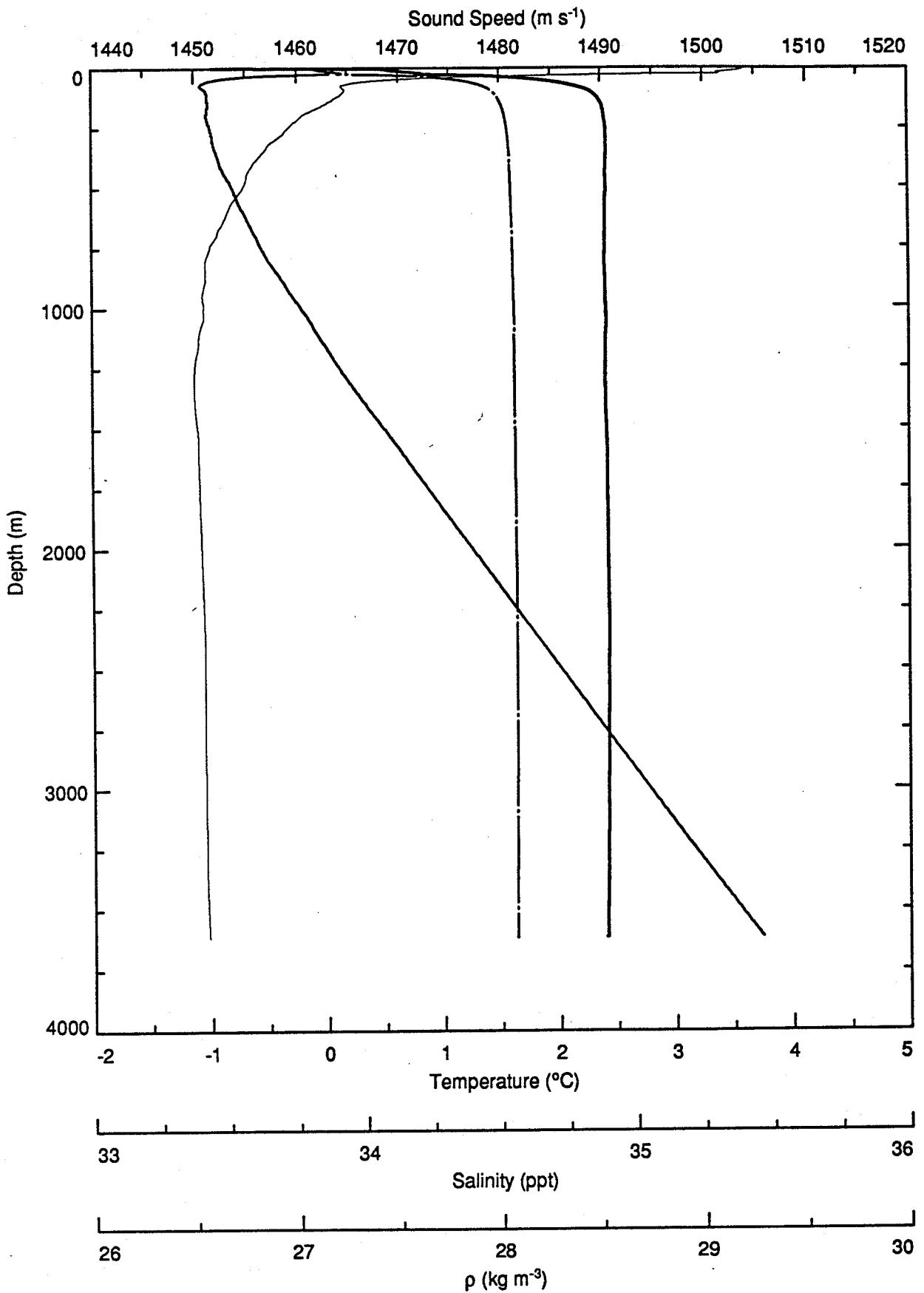
Sound speed = medium line

Density (σ_θ) = dashed line.

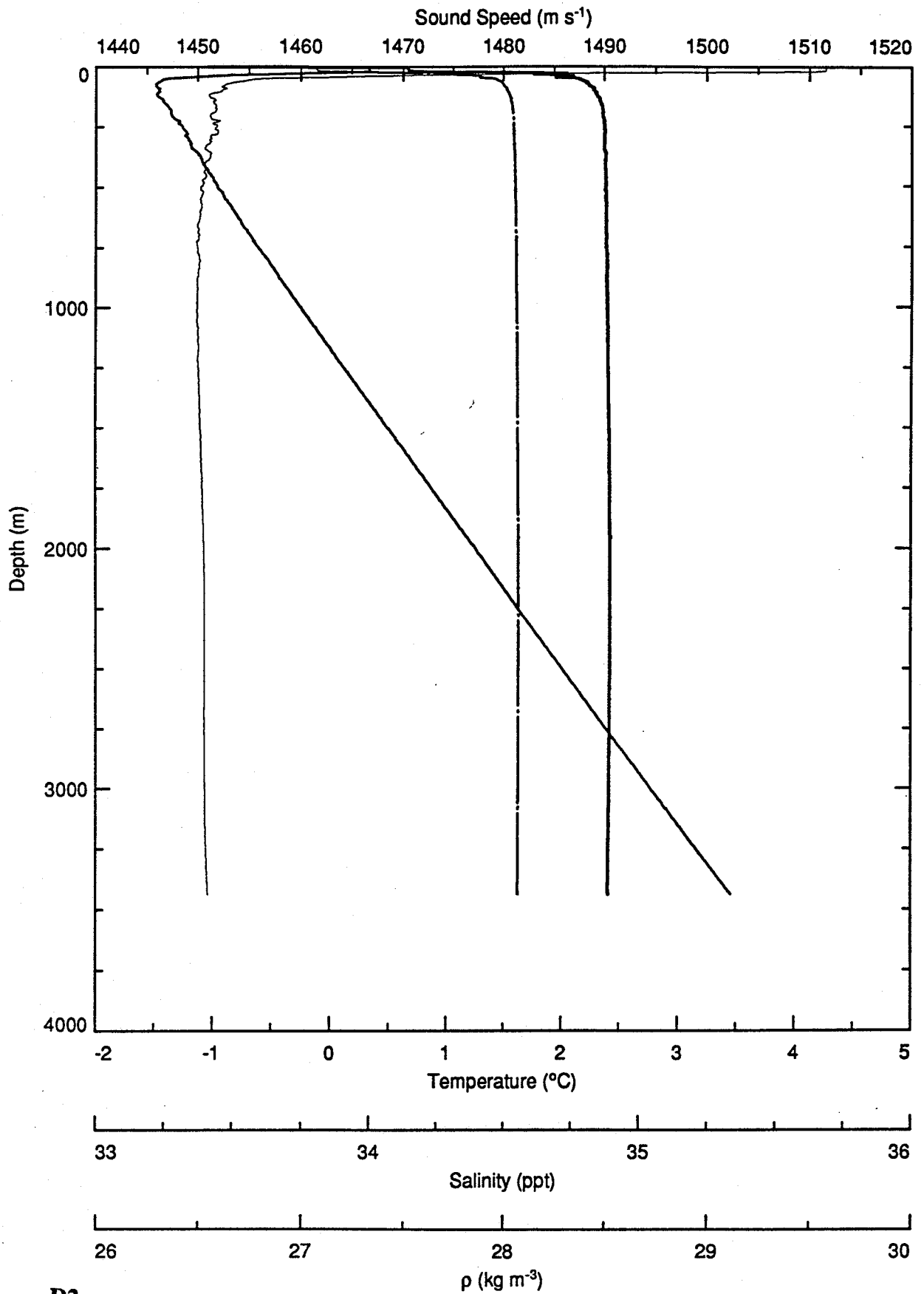
For the XBT waterfall plots, the profiles are offset by 0.5°C.

For the XSV waterfall plots, the profiles are offset by 10 m/s.

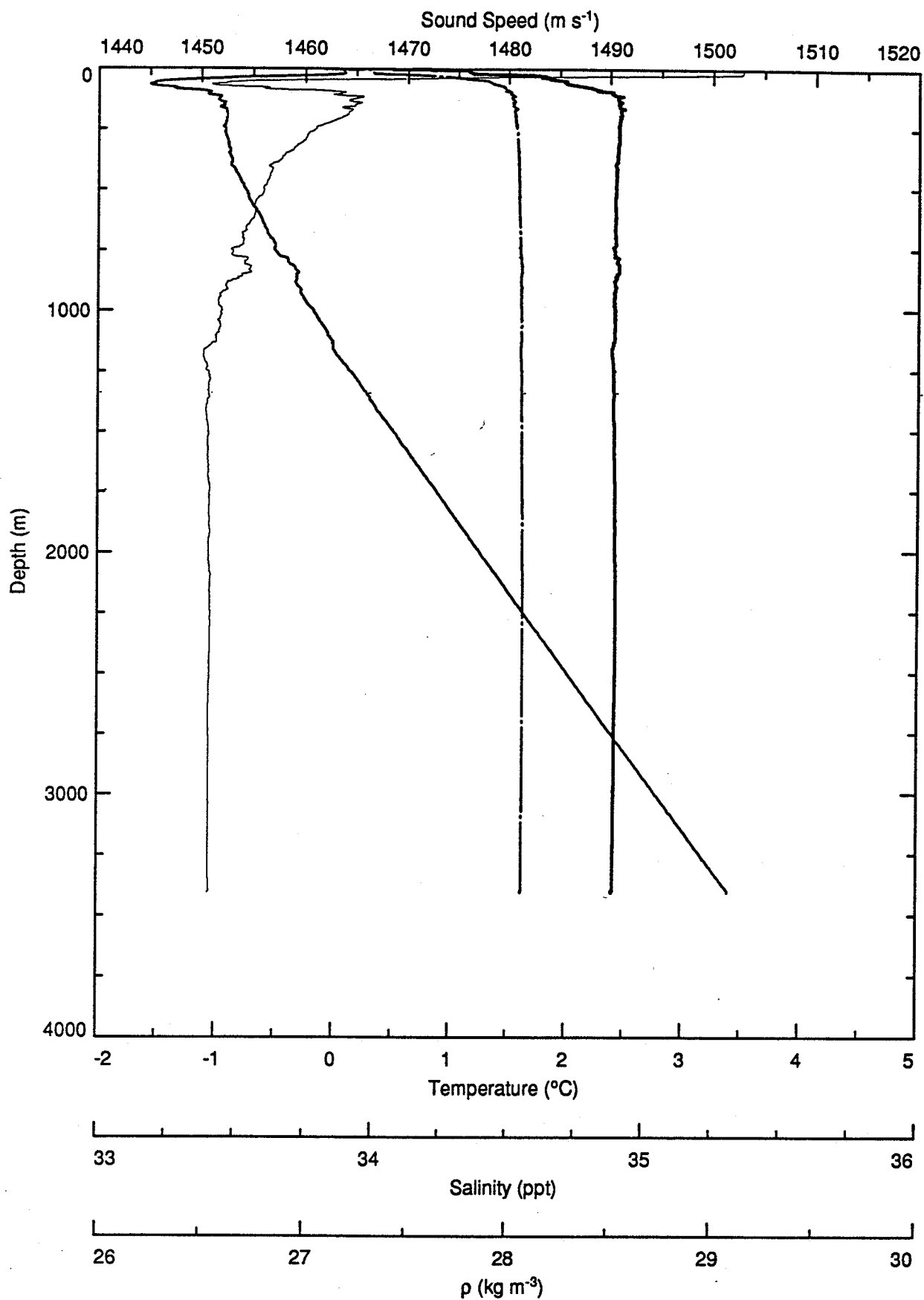
GSP Recovery CTD Cast 001



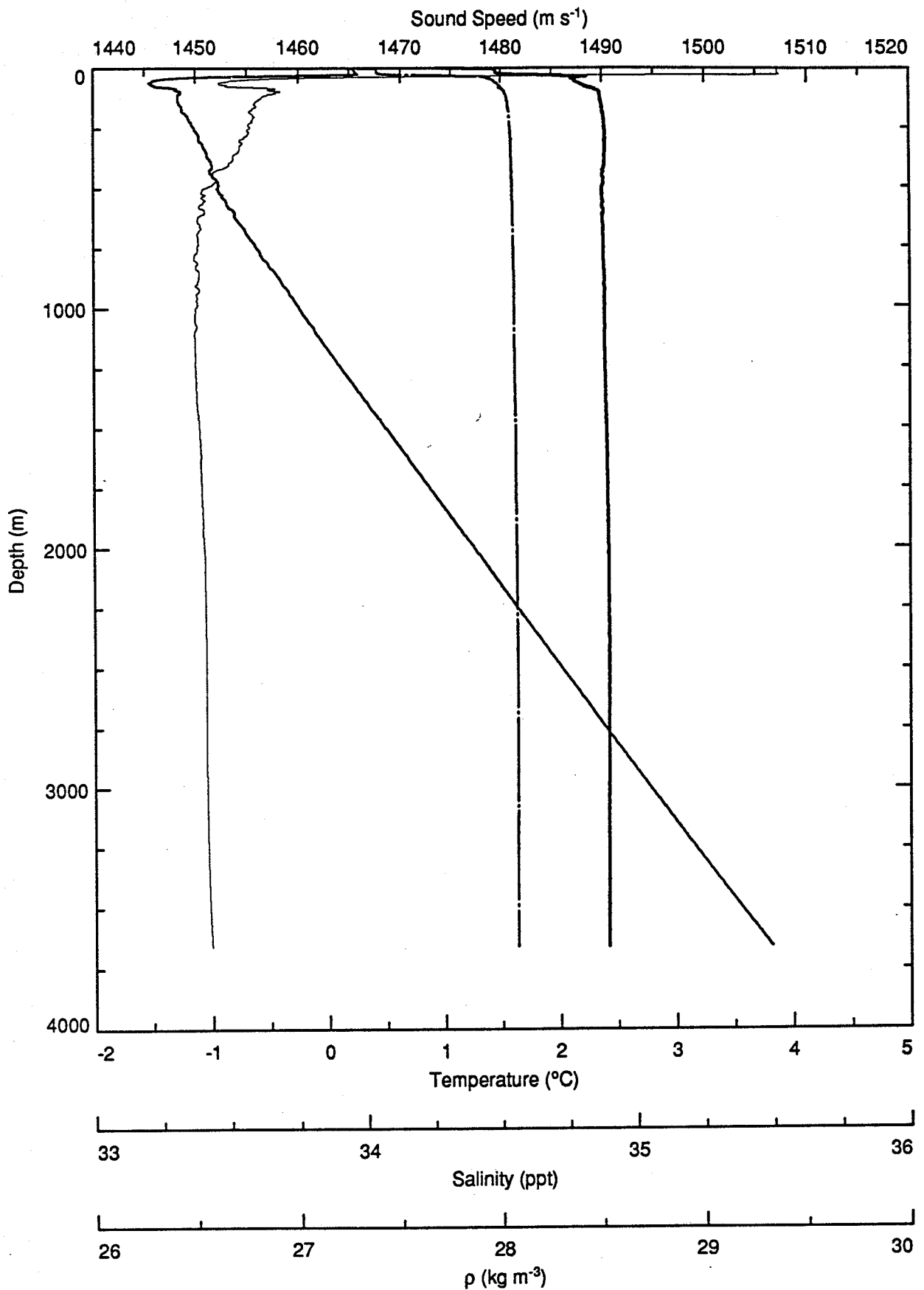
GSP Recovery CTD Cast 002



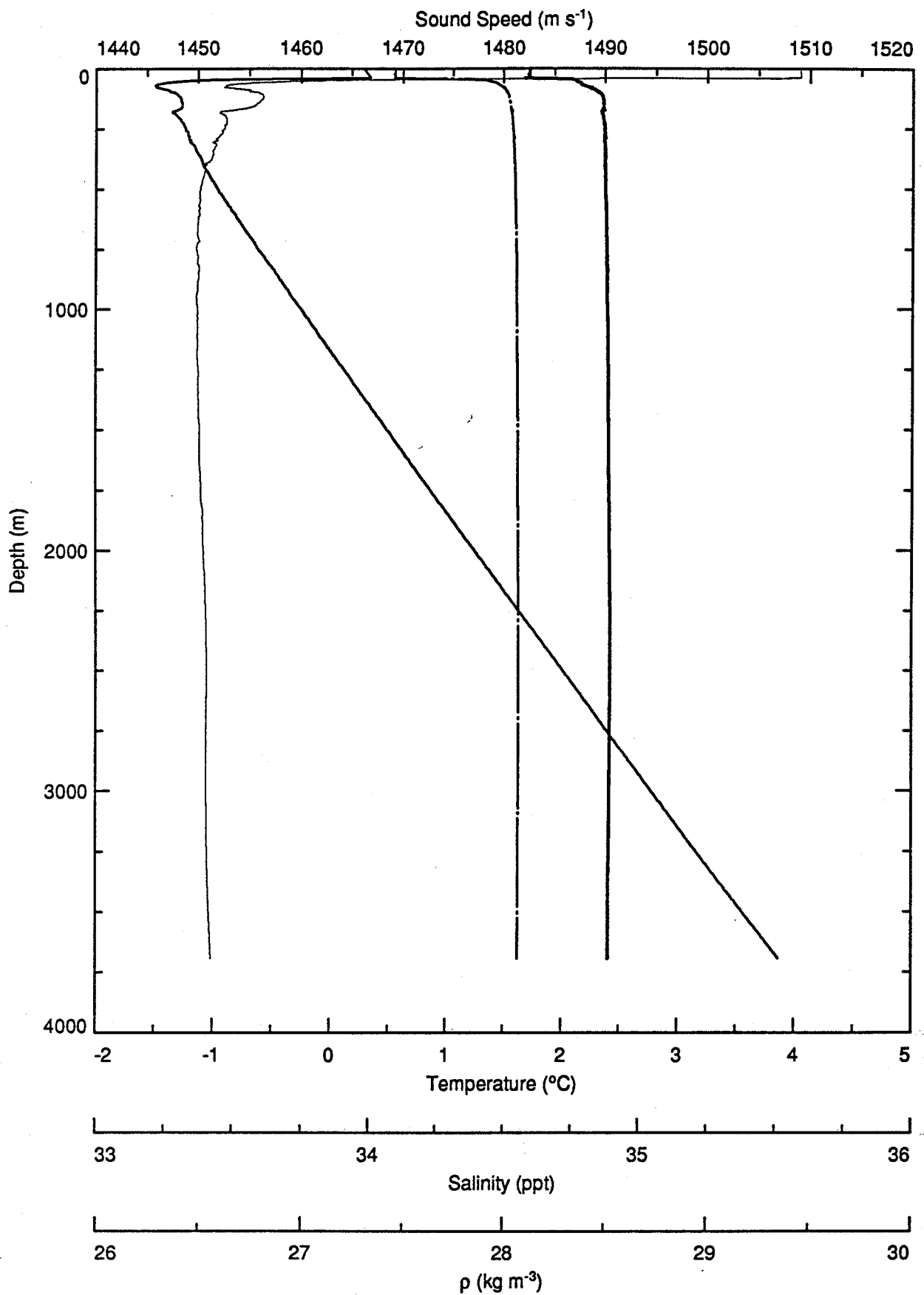
GSP Recovery CTD Cast 004



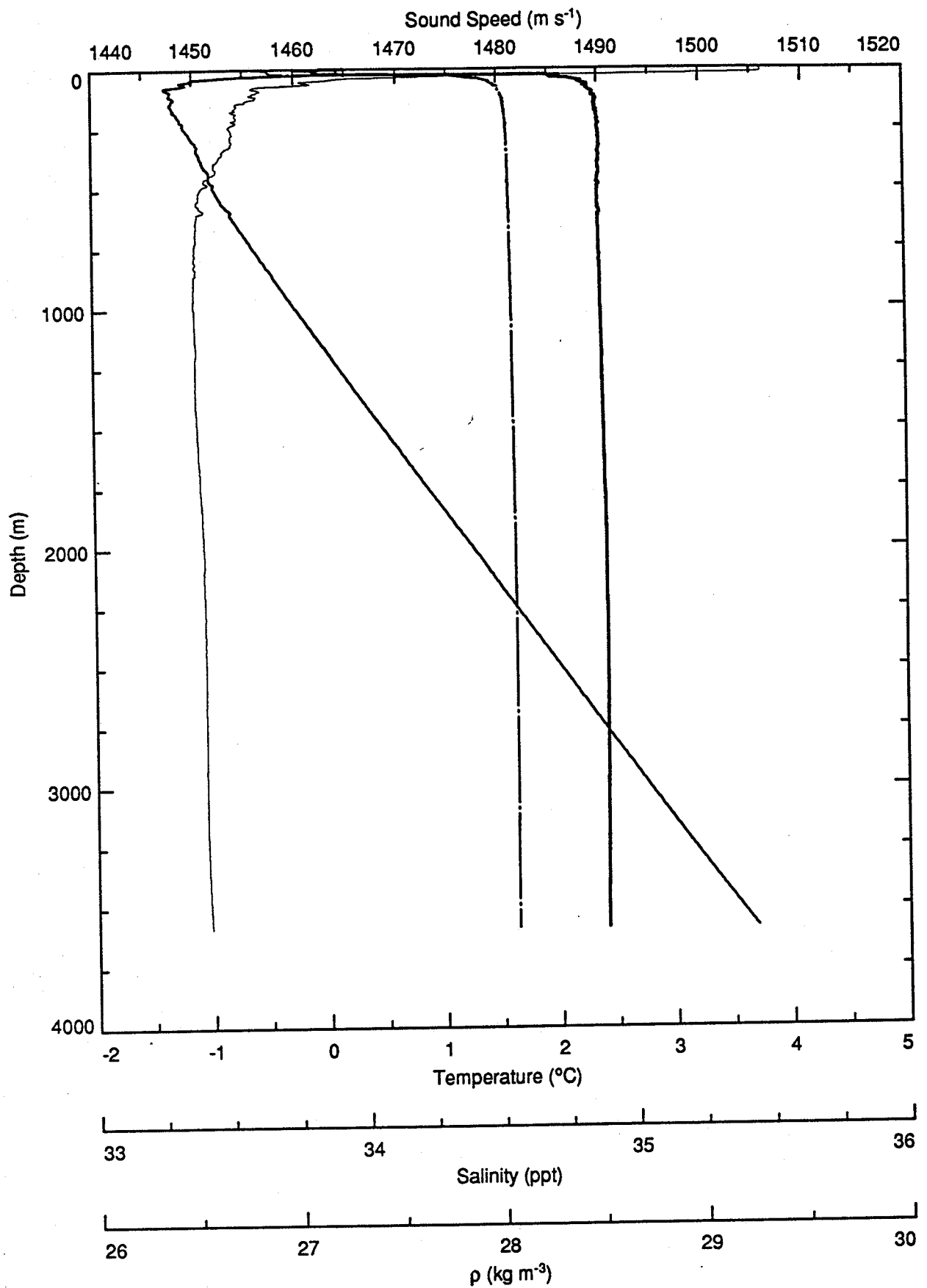
GSP Recovery CTD Cast 005



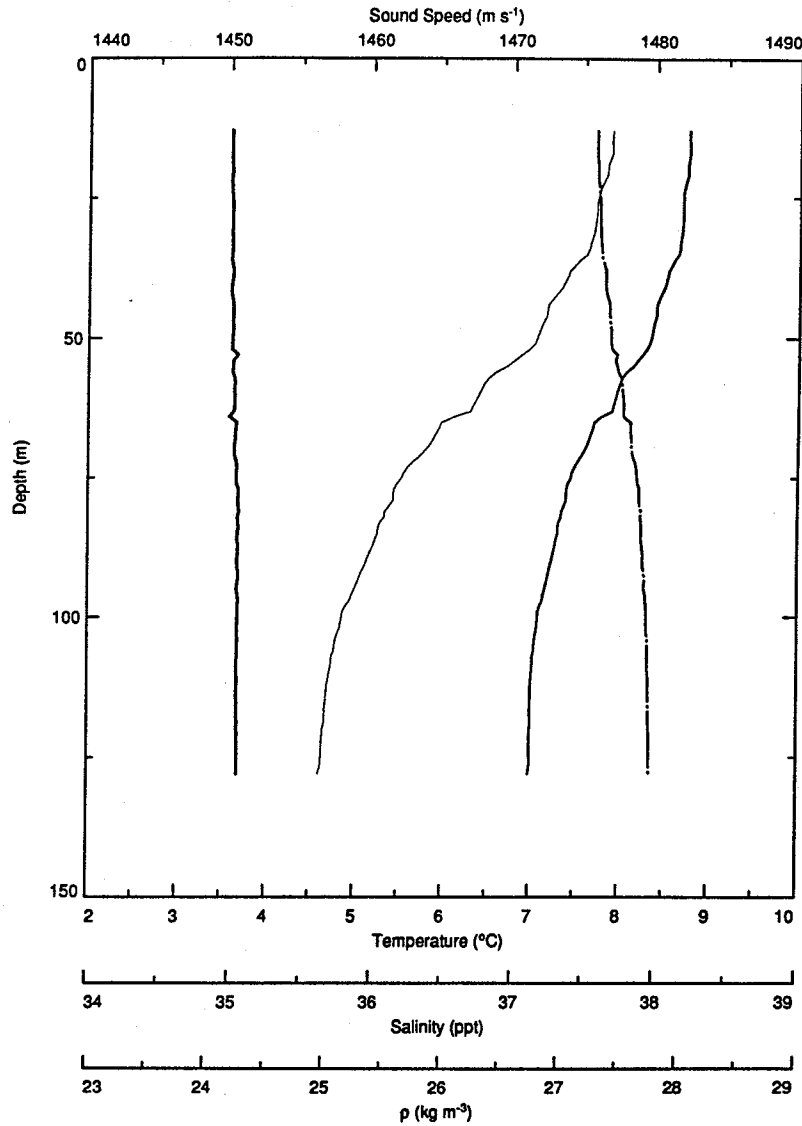
GSP Recovery CTD Cast 006



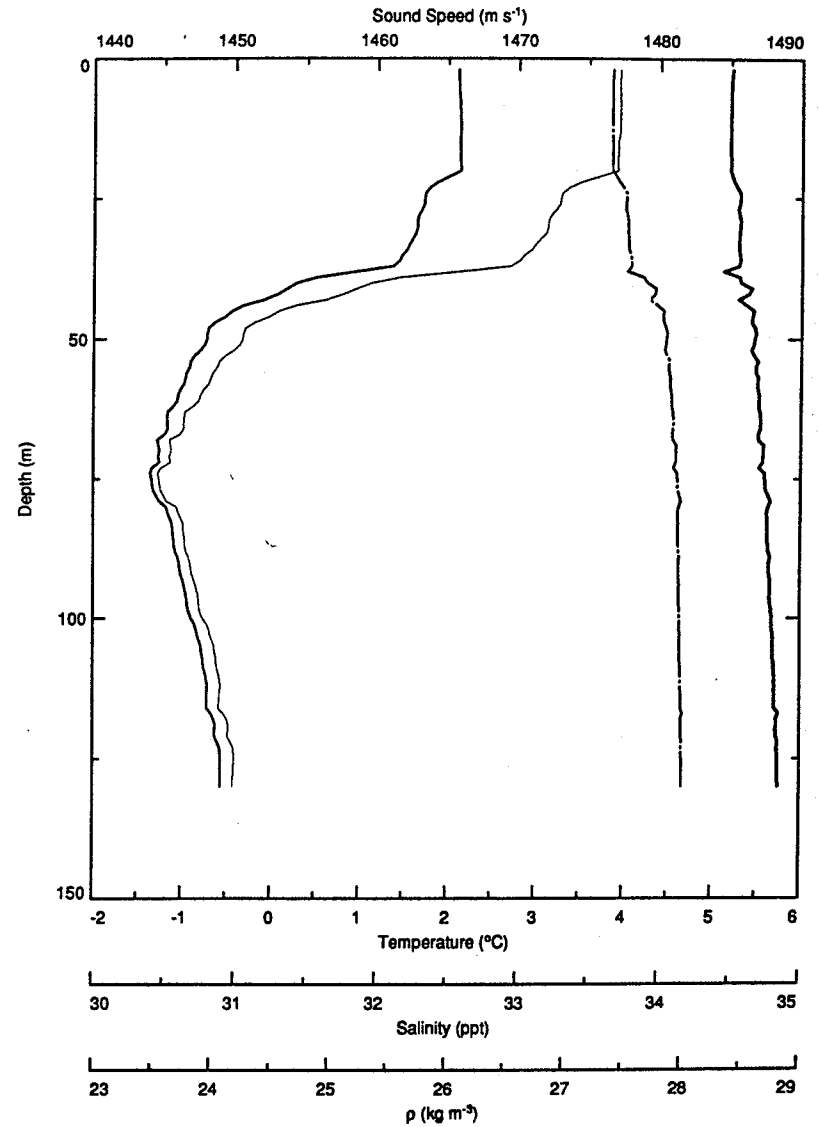
GSP Recovery CTD Cast 007



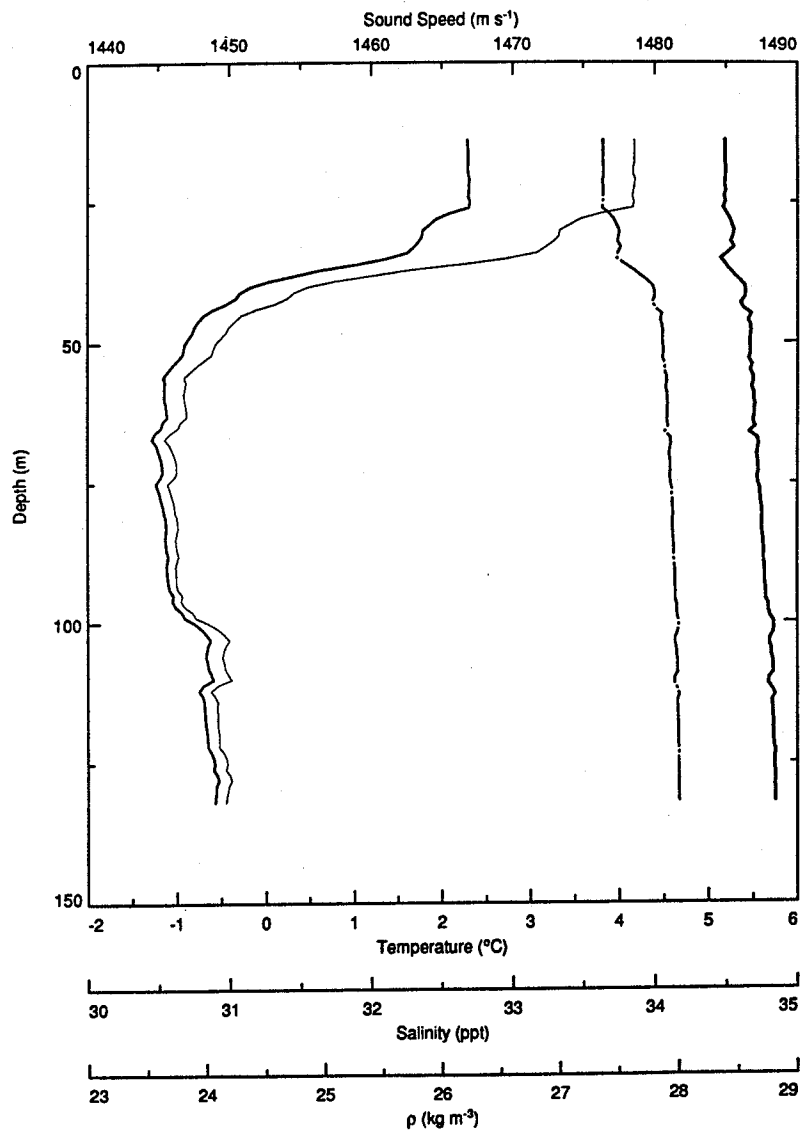
1989 MST : CTD Cast 001



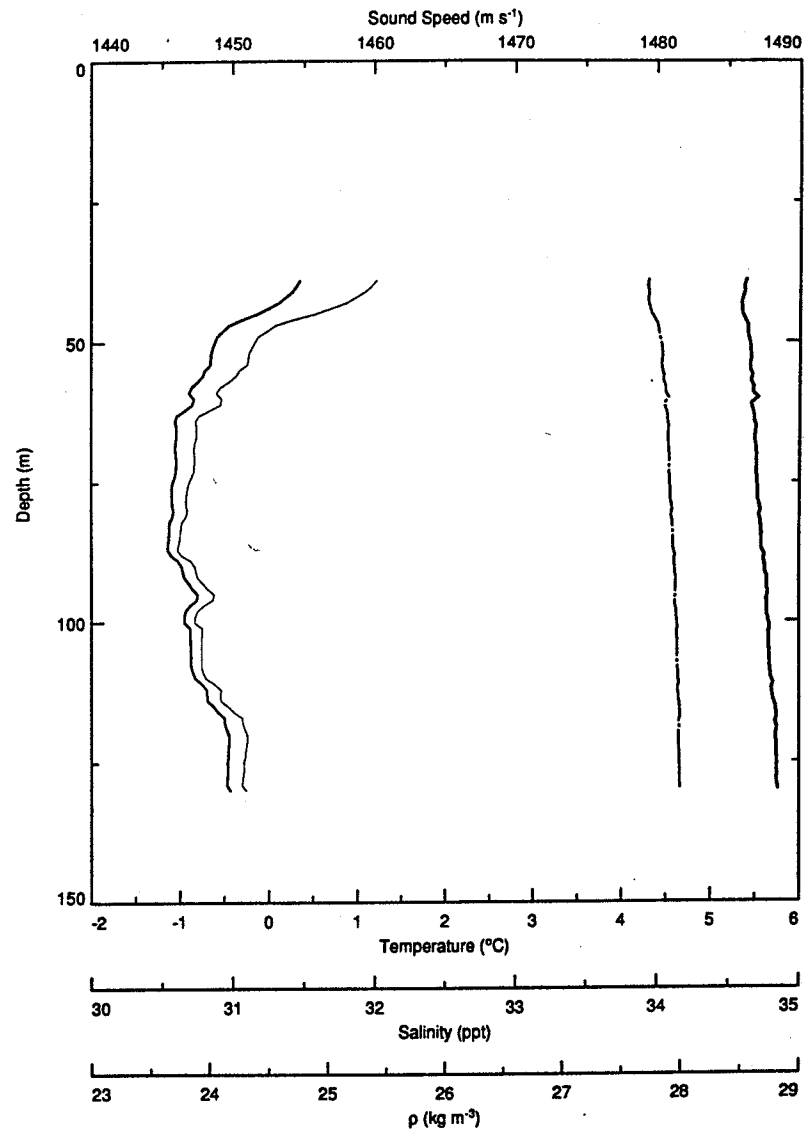
1989 MST : CTD Cast 015



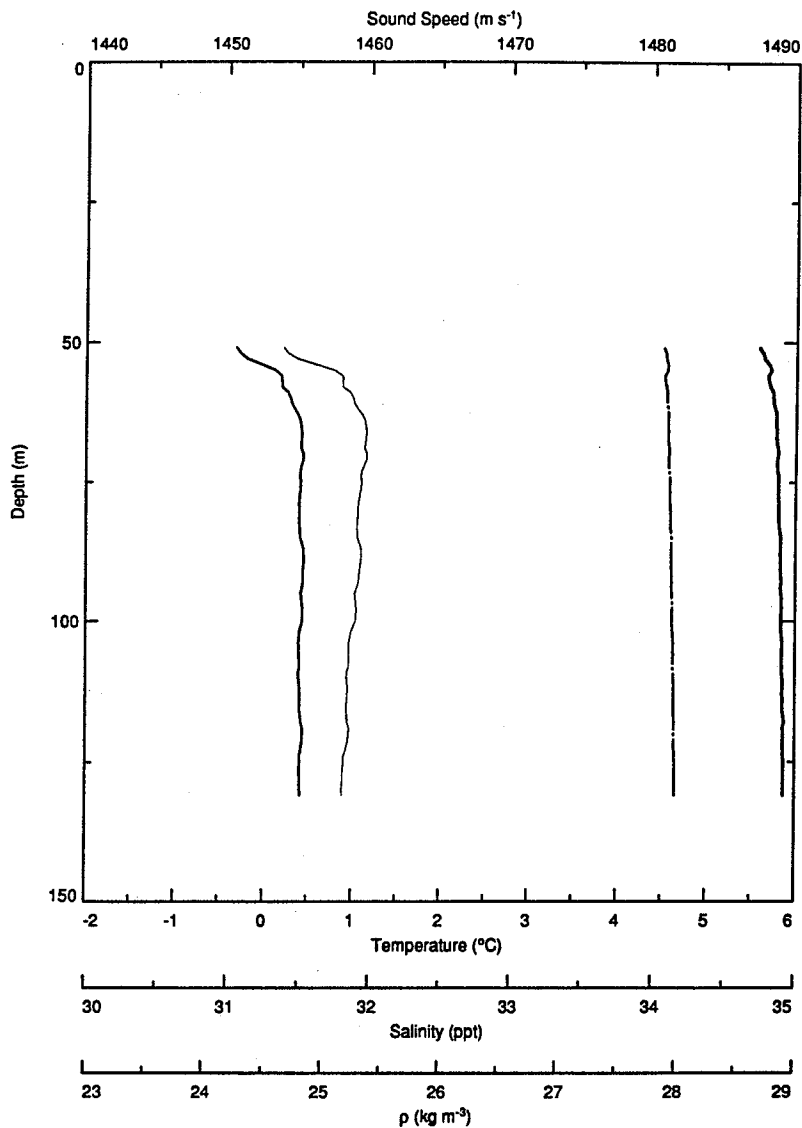
1989 MST : CTD Cast 016



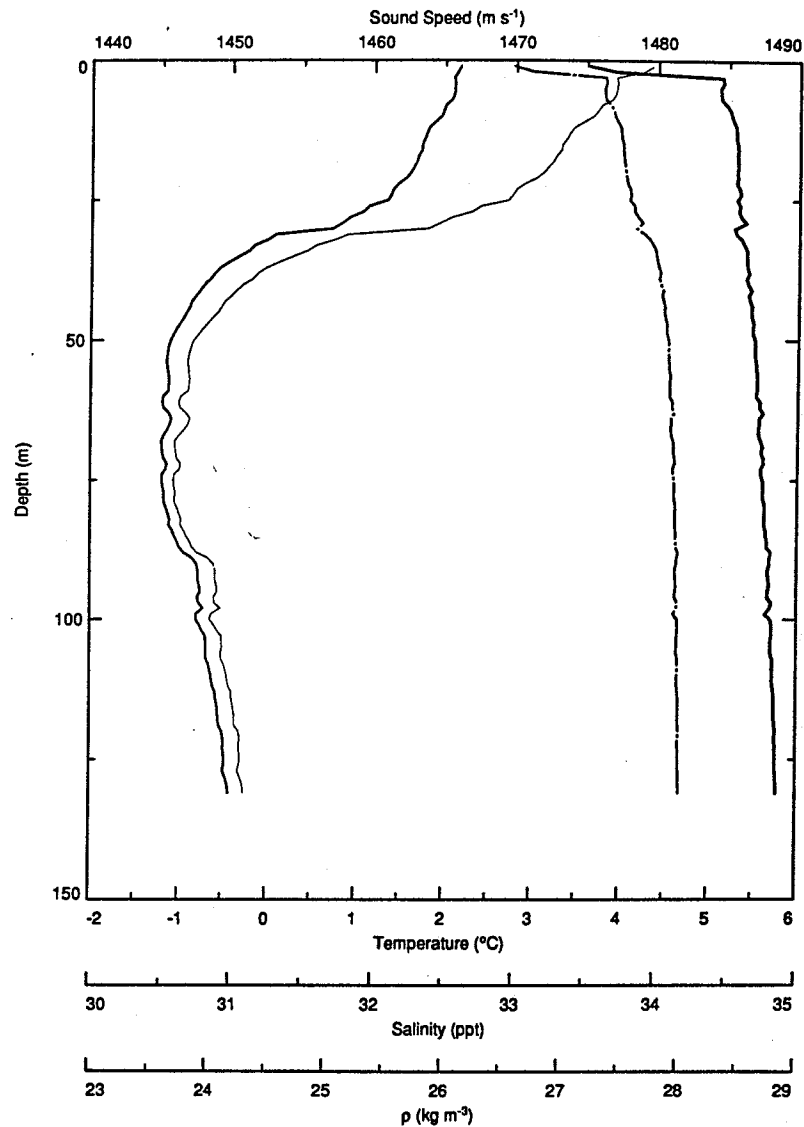
1989 MST : CTD Cast 017



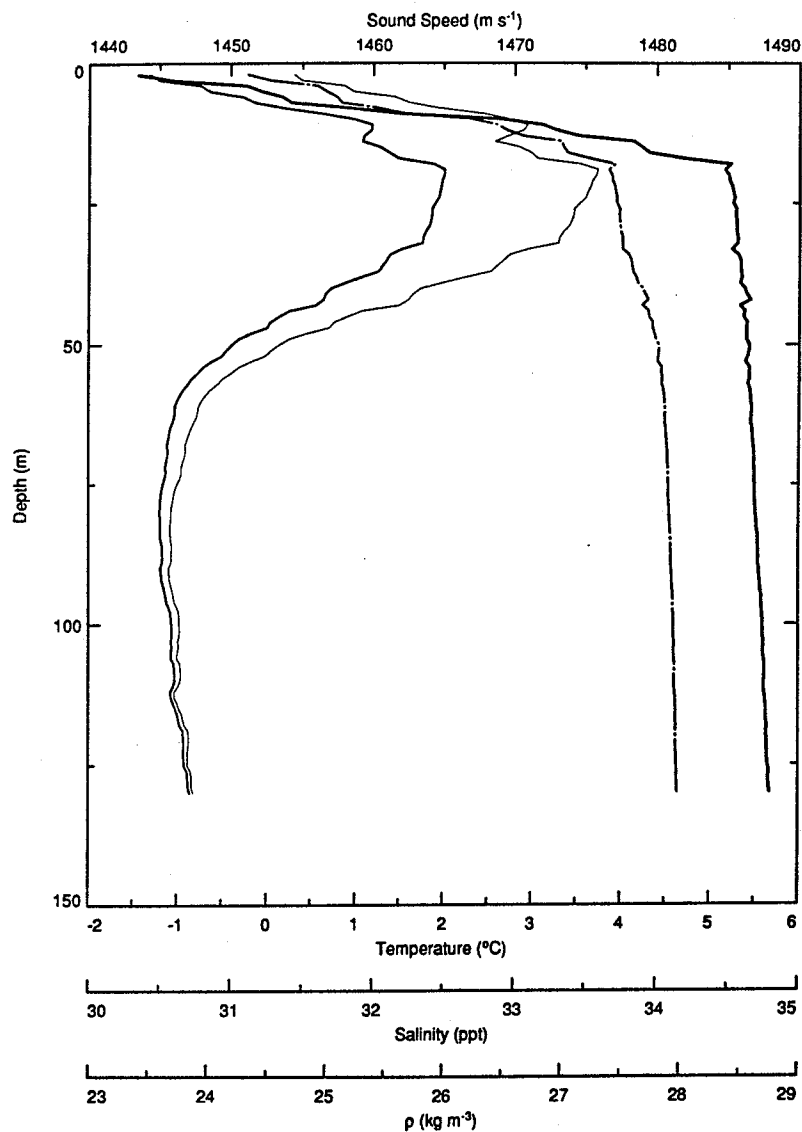
1989 MST : CTD Cast 018



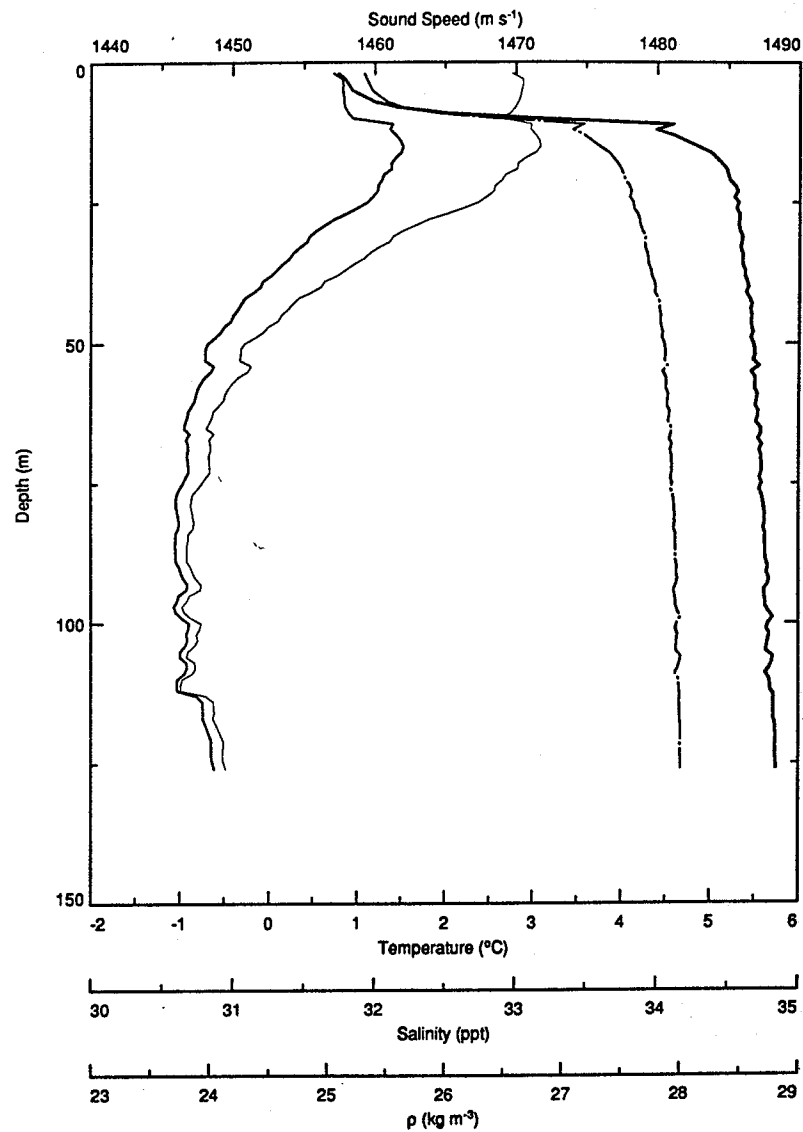
1989 MST : CTD Cast 019



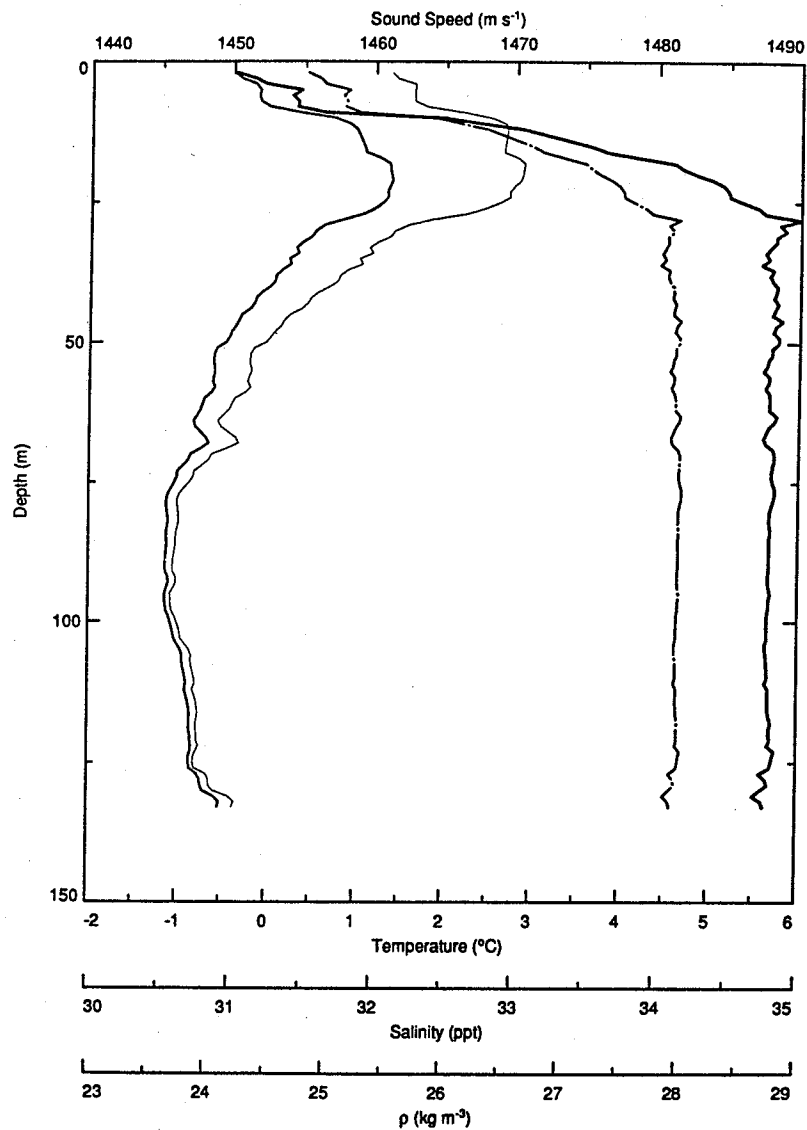
1989 MST : CTD Cast 021



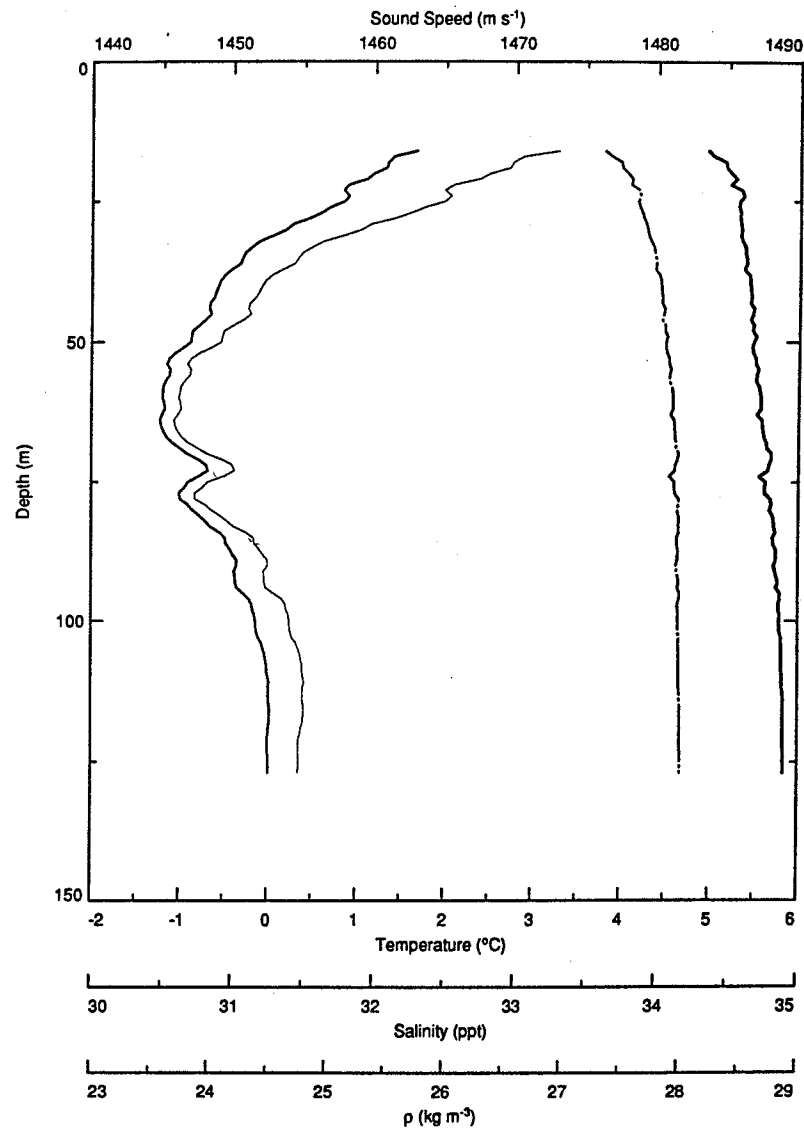
1989 MST : CTD Cast 023



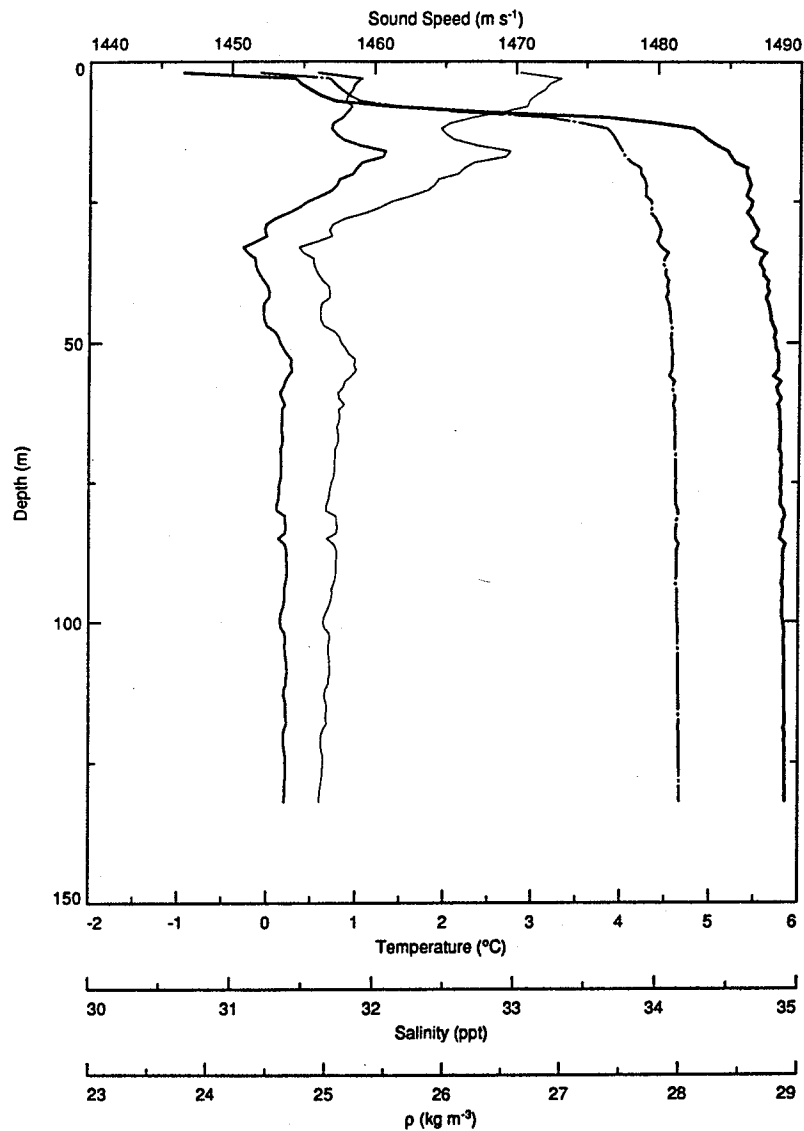
1989 MST : CTD Cast 025



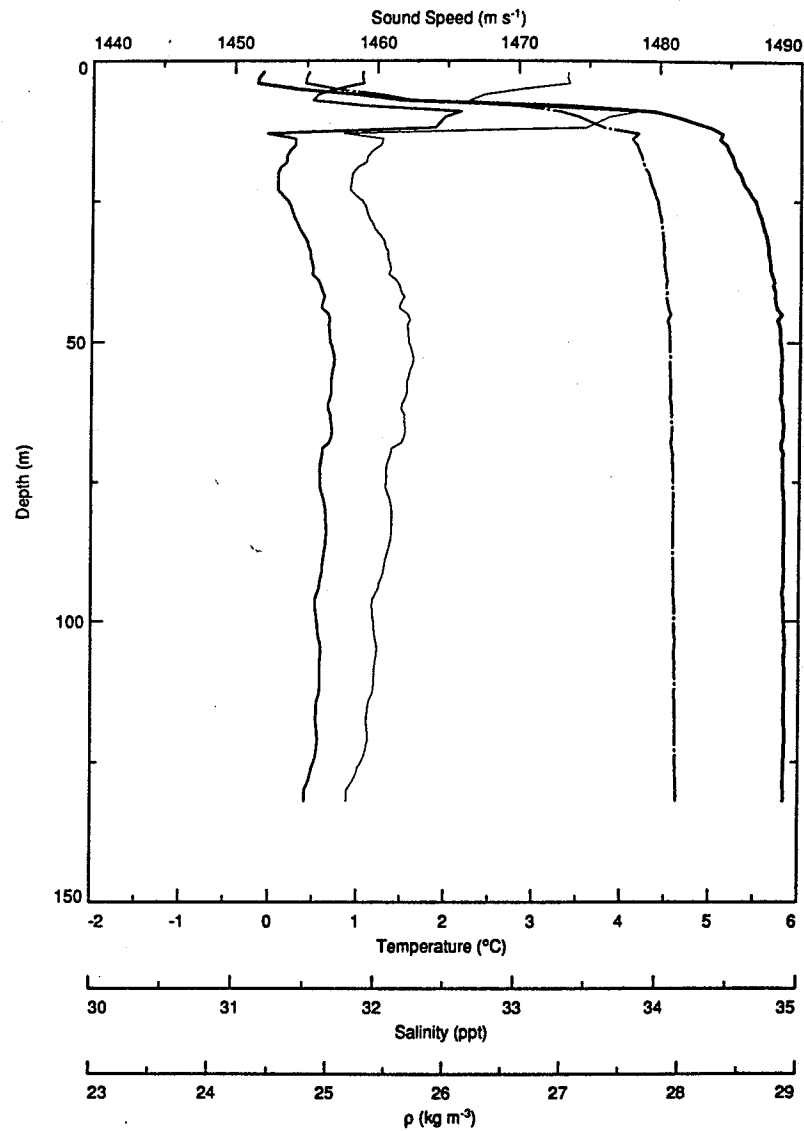
1989 MST : CTD Cast 026



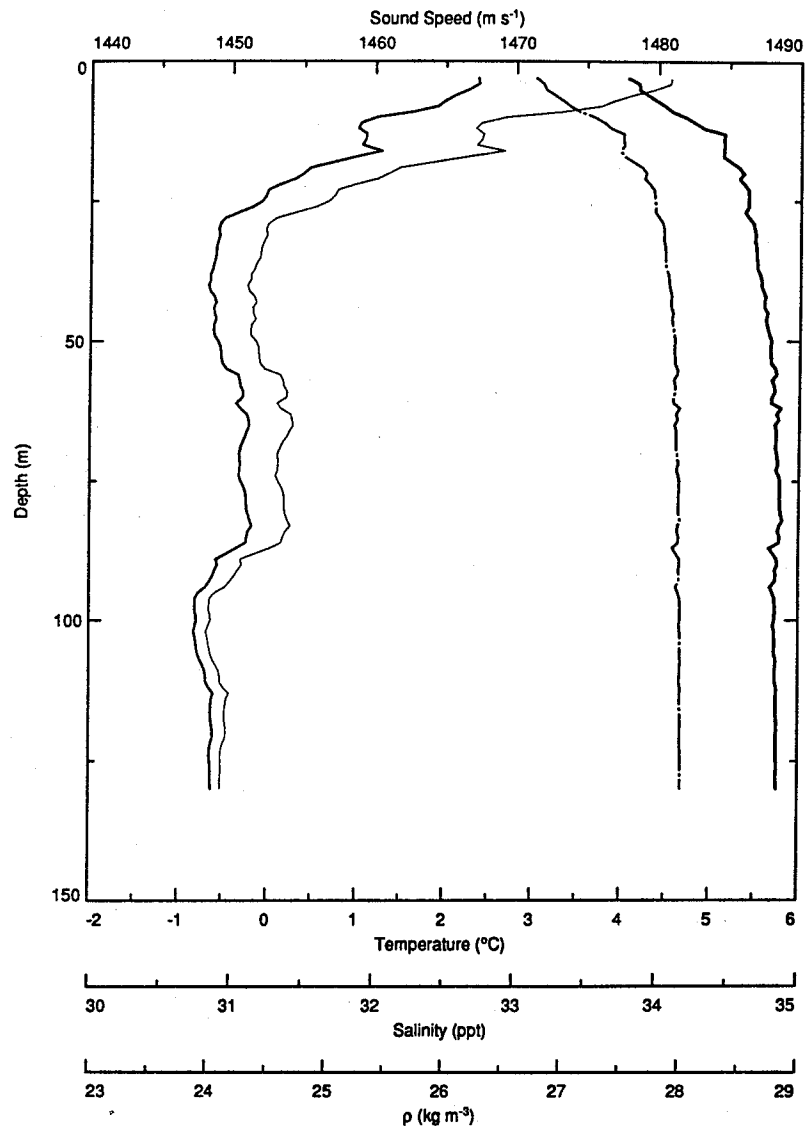
1989 MST : CTD Cast 028



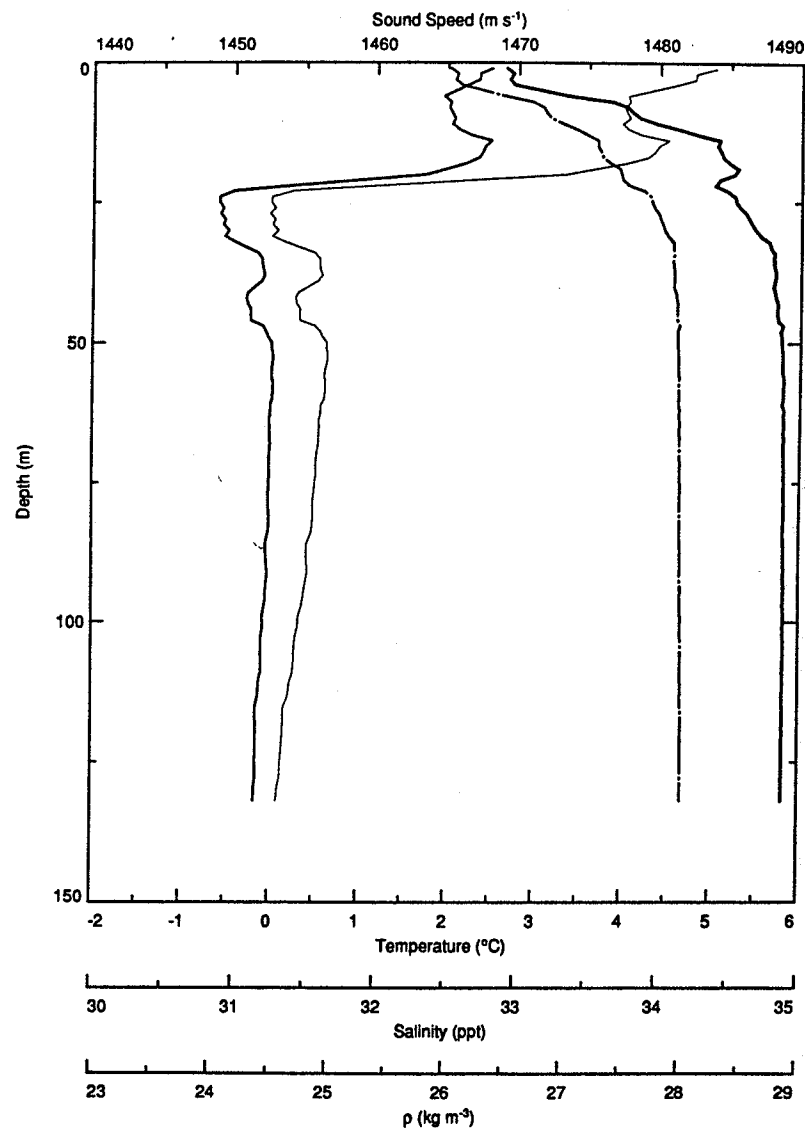
1989 MST : CTD Cast 029



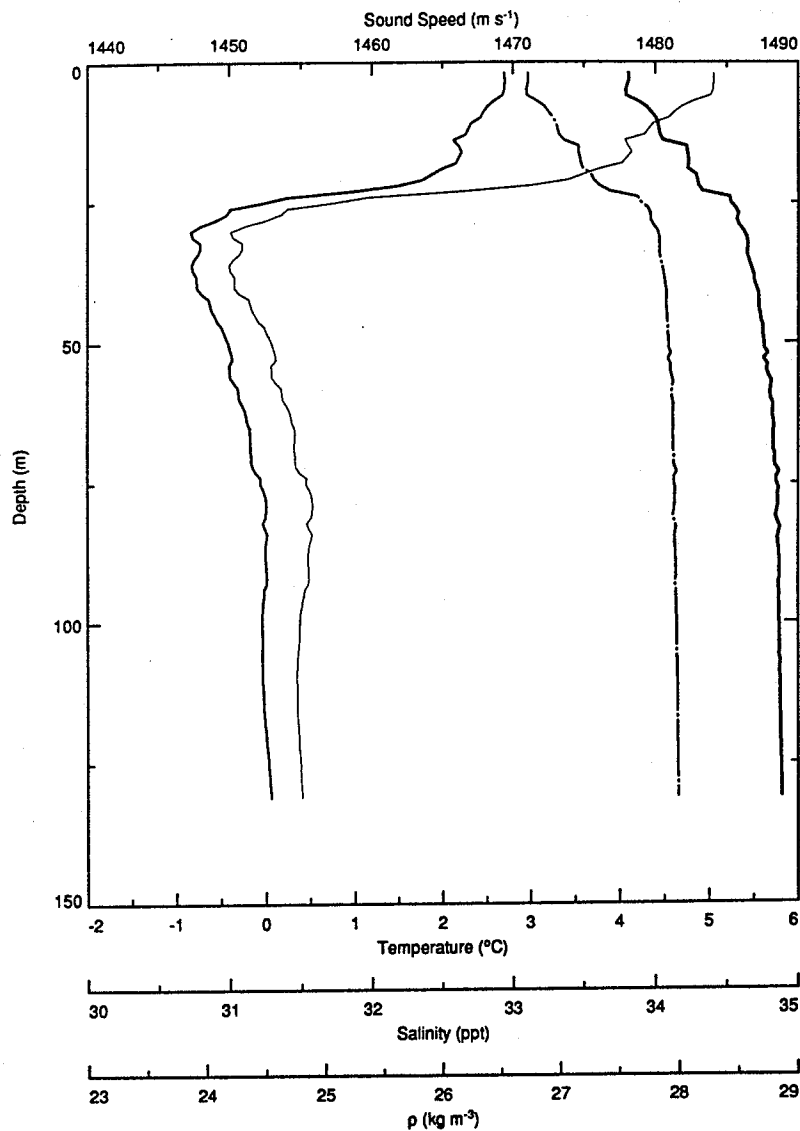
1989 MST : CTD Cast 031



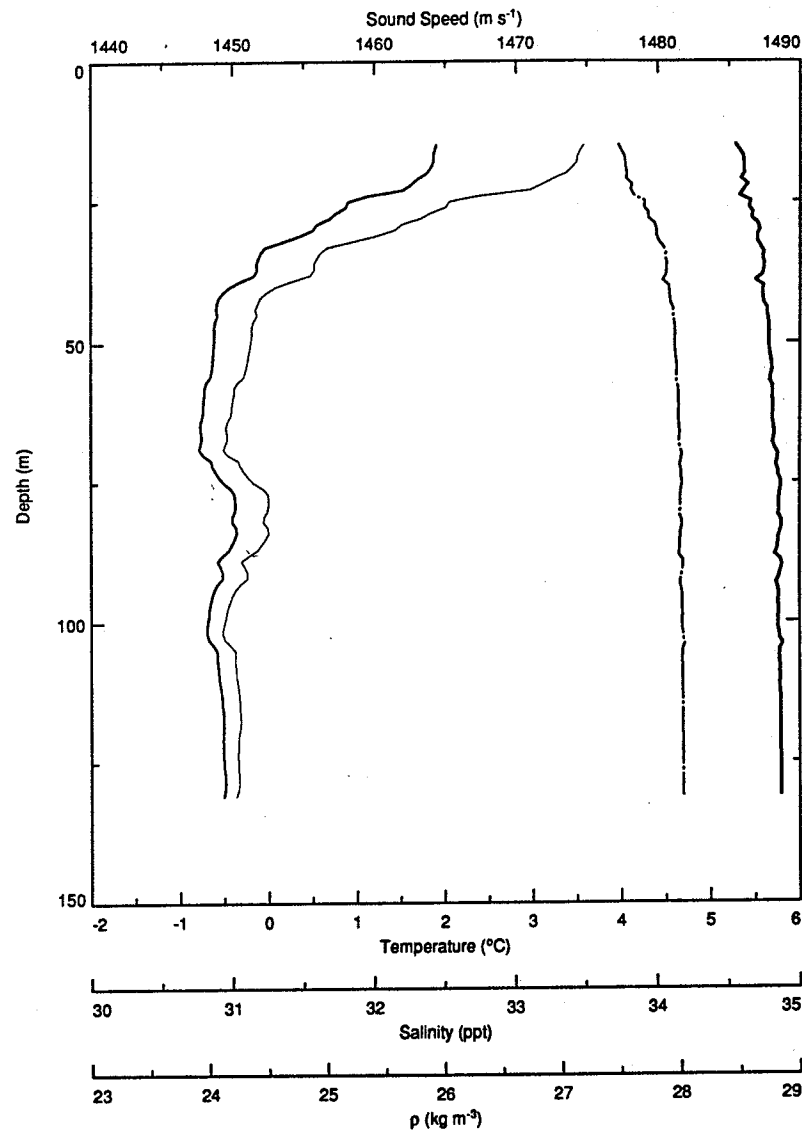
1989 MST : CTD Cast 032



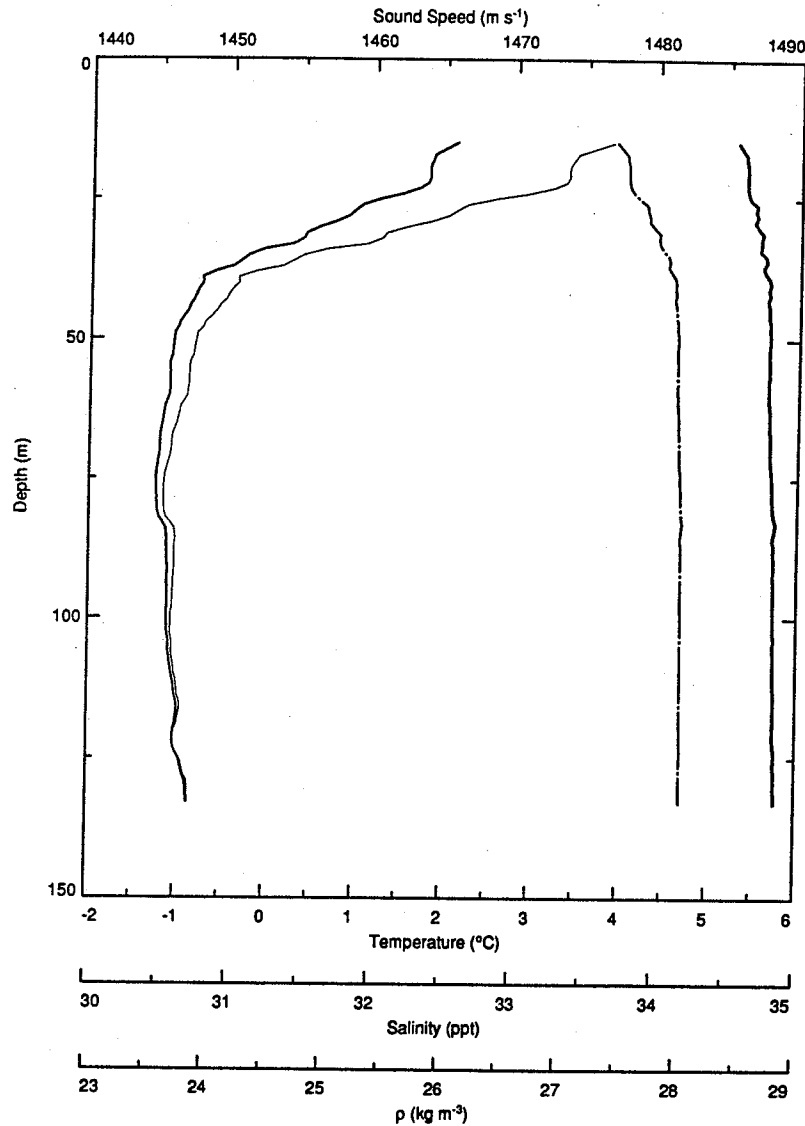
1989 MST : CTD Cast 033



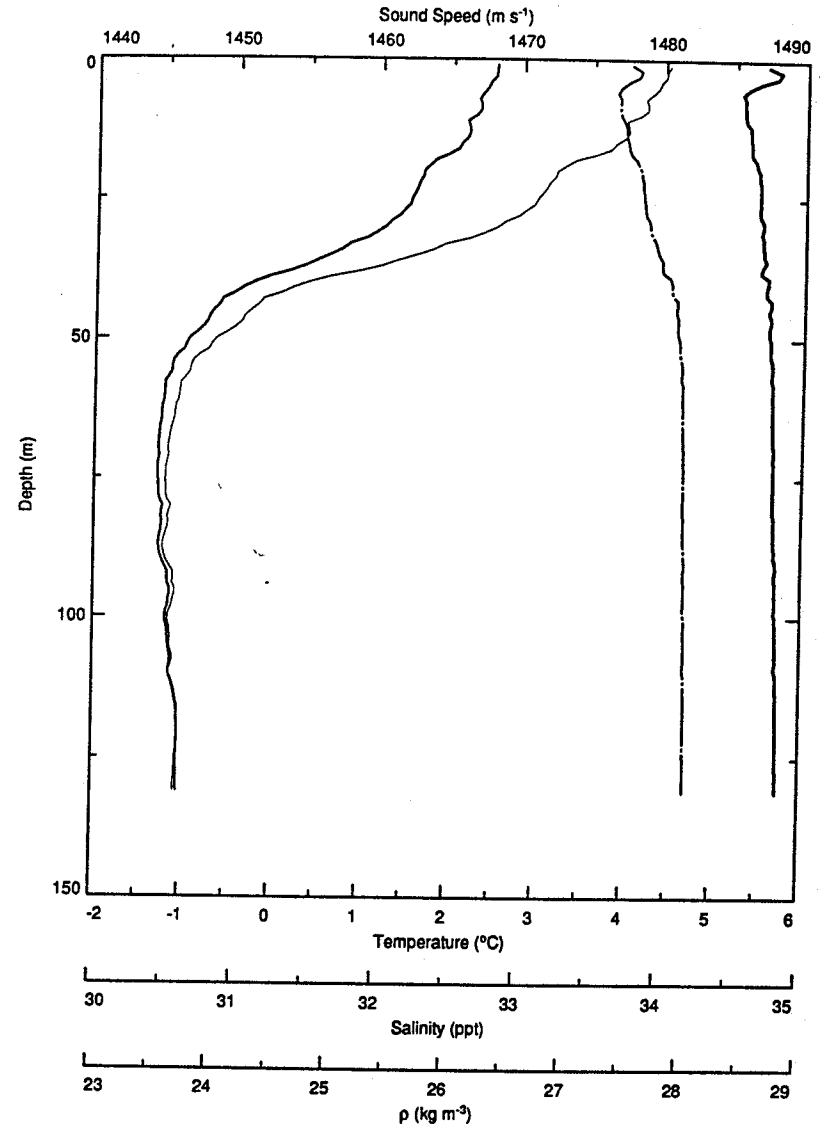
1989 MST : CTD Cast 034



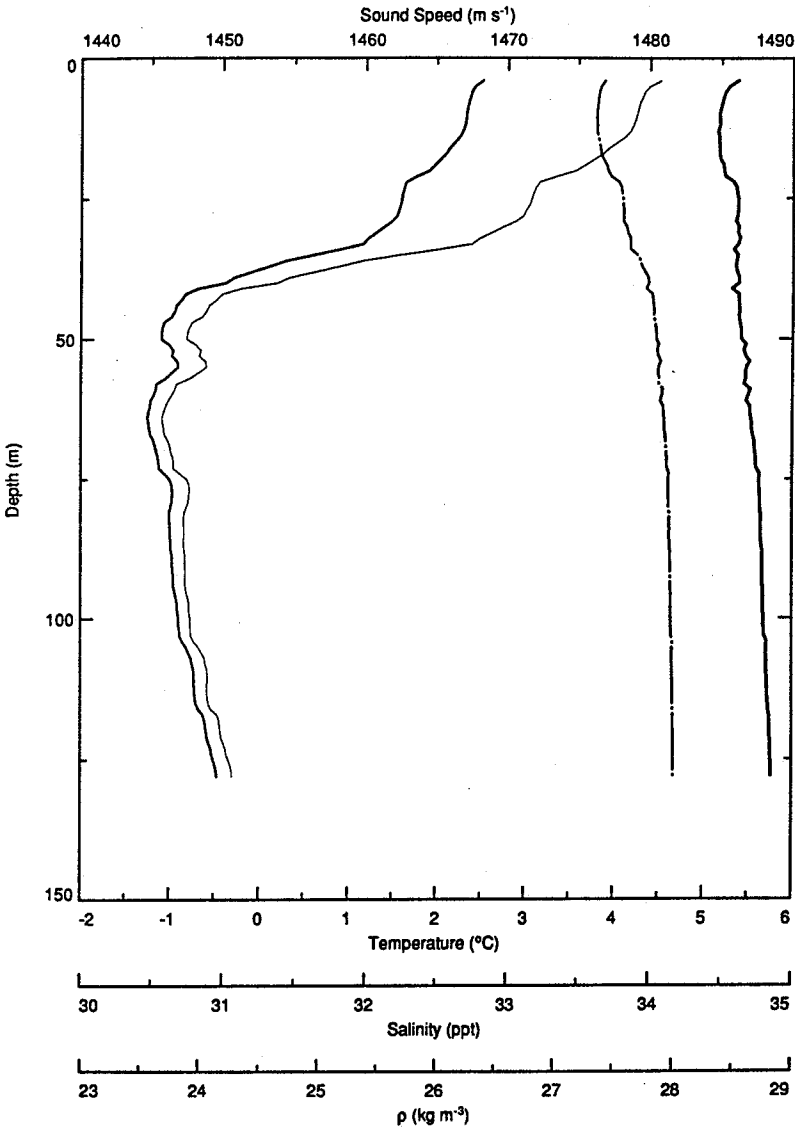
1989 MST : CTD Cast 035



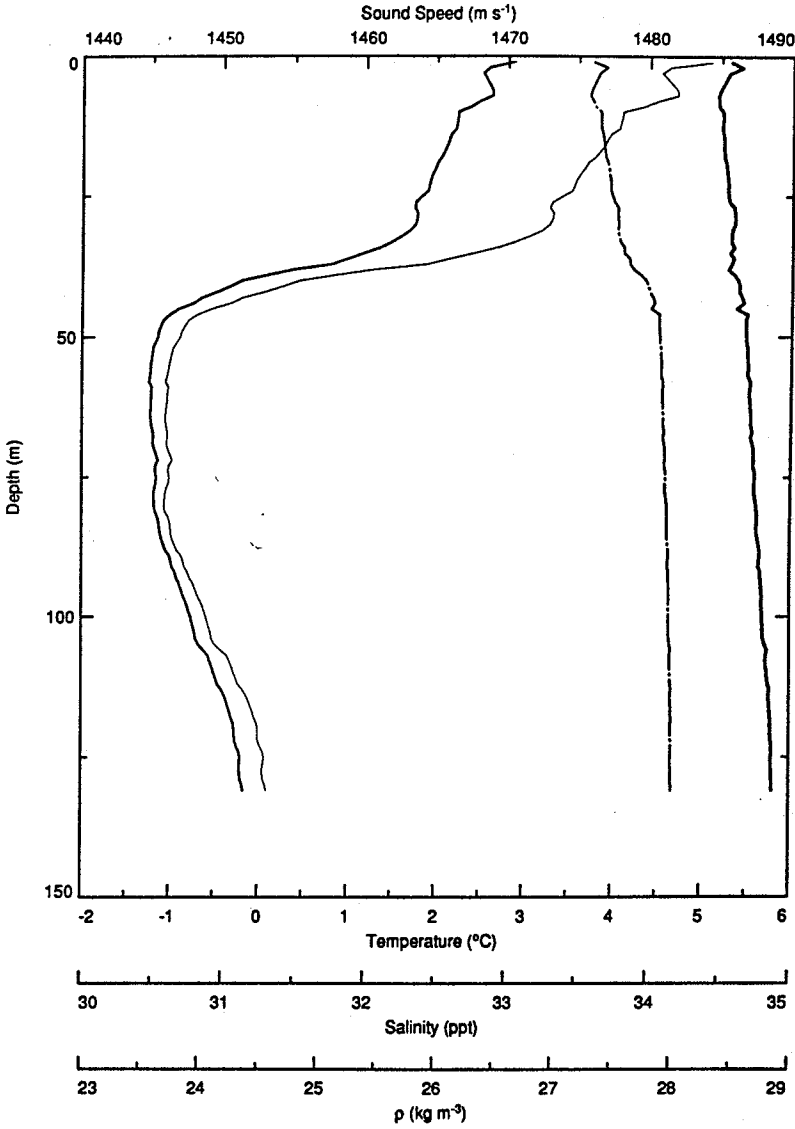
1989 MST : CTD Cast 036



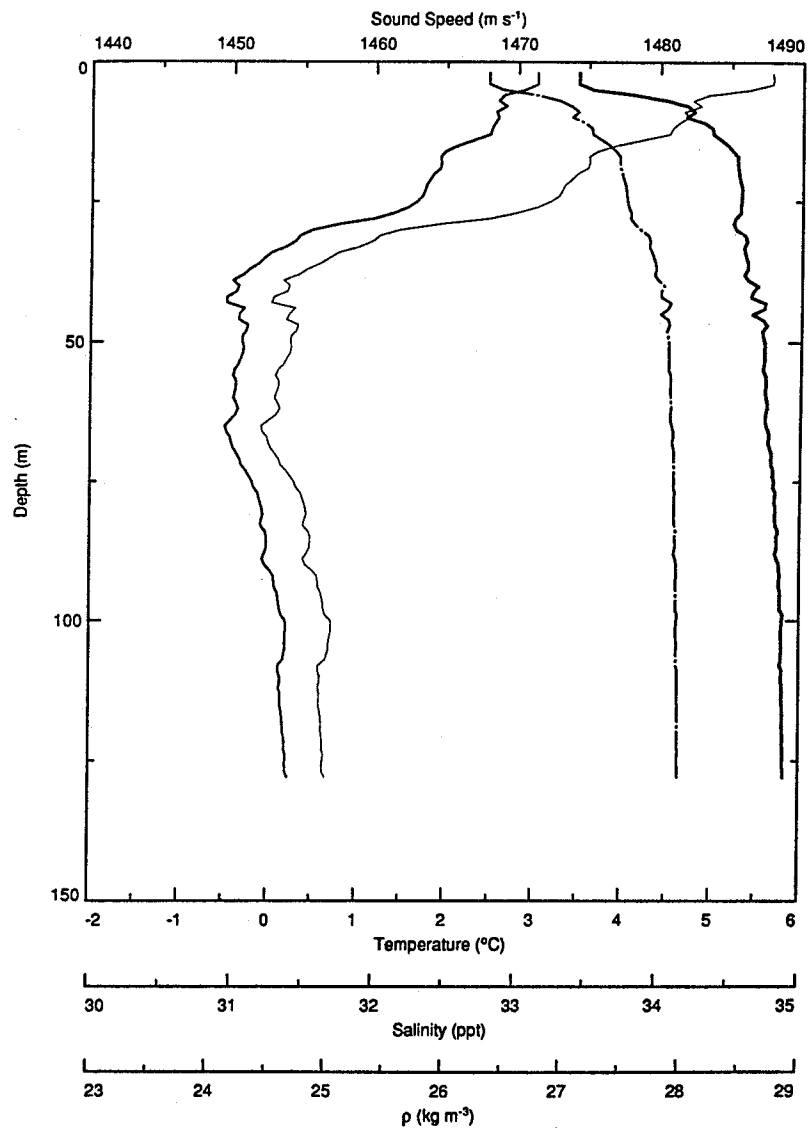
1989 MST : CTD Cast 037



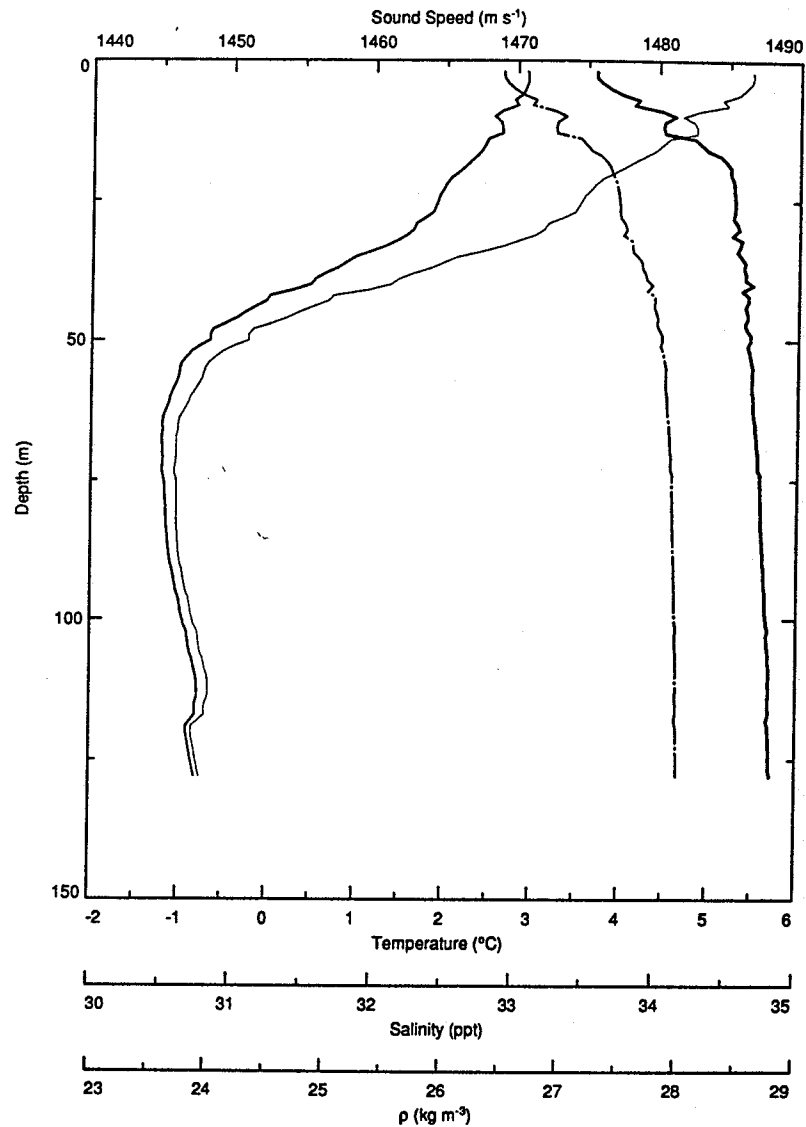
1989 MST : CTD Cast 038



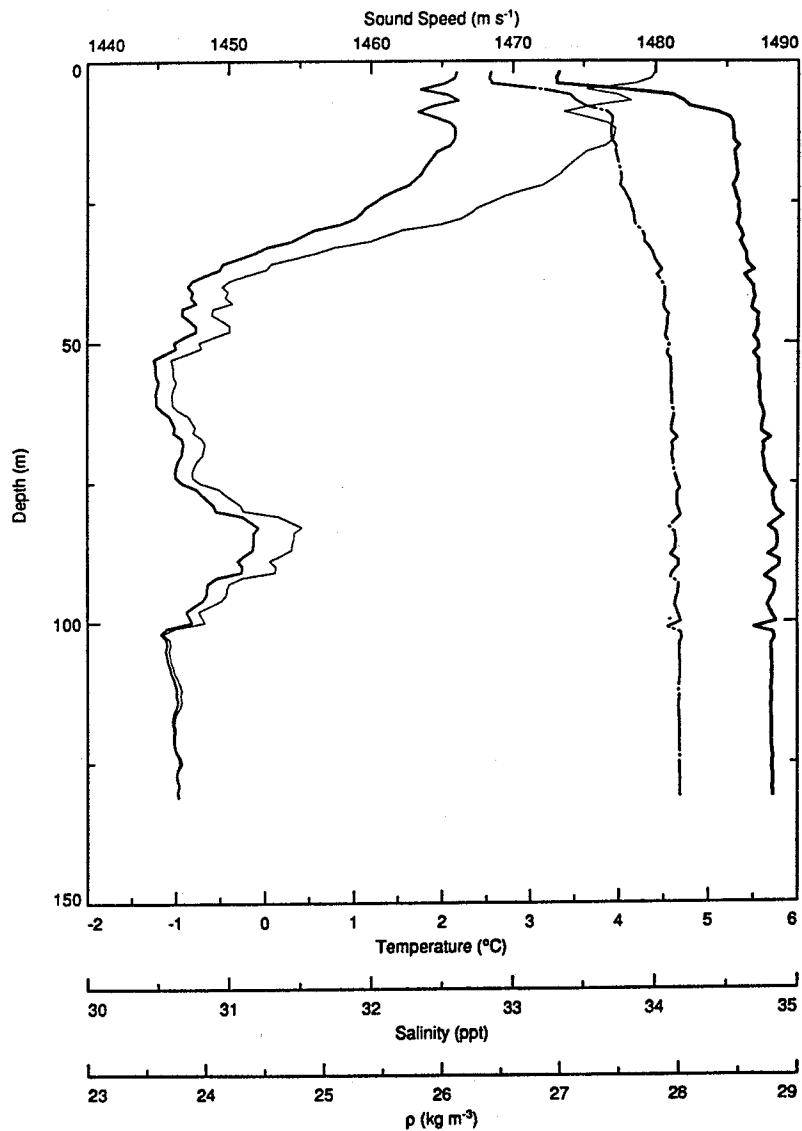
1989 MST : CTD Cast 039



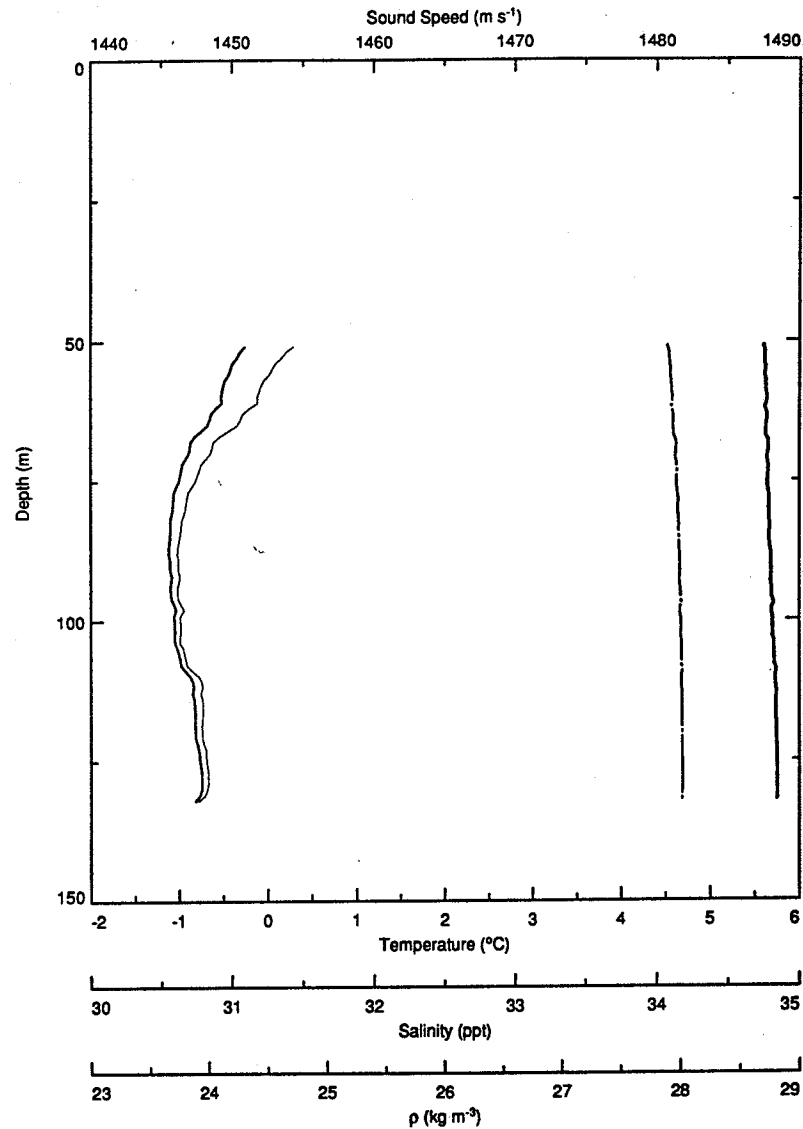
1989 MST : CTD Cast 040



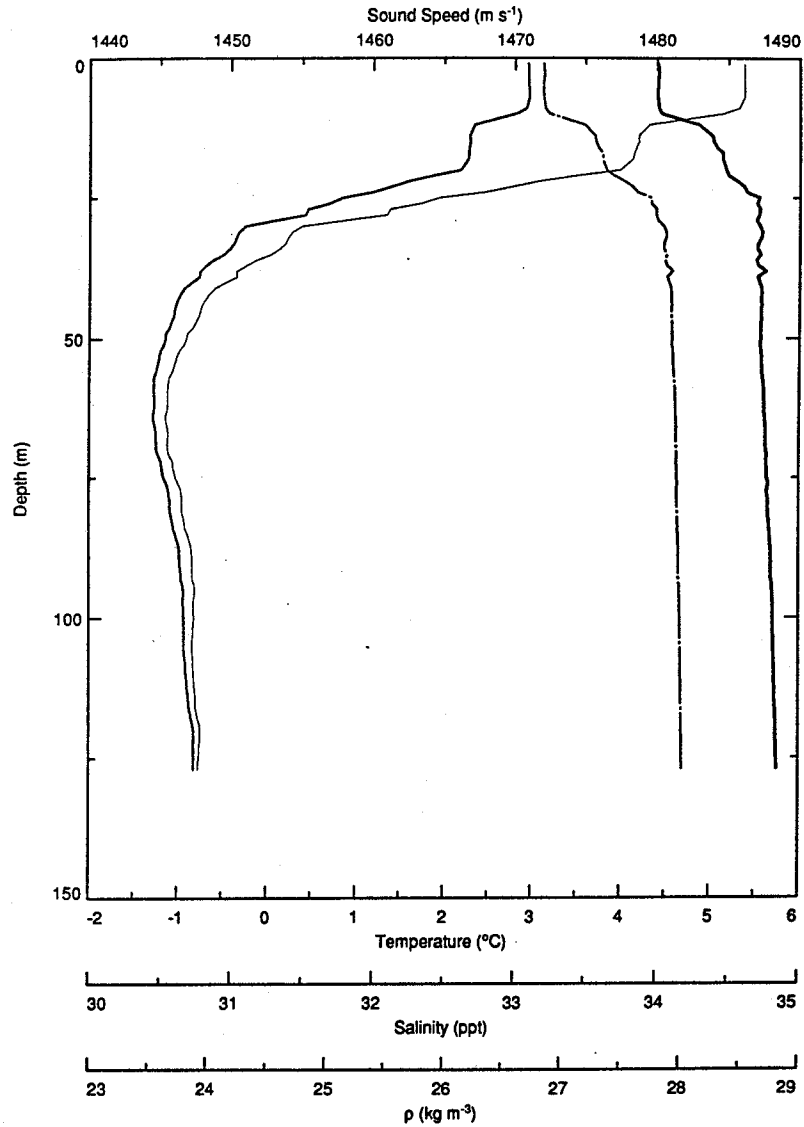
1989 MST : CTD Cast 041



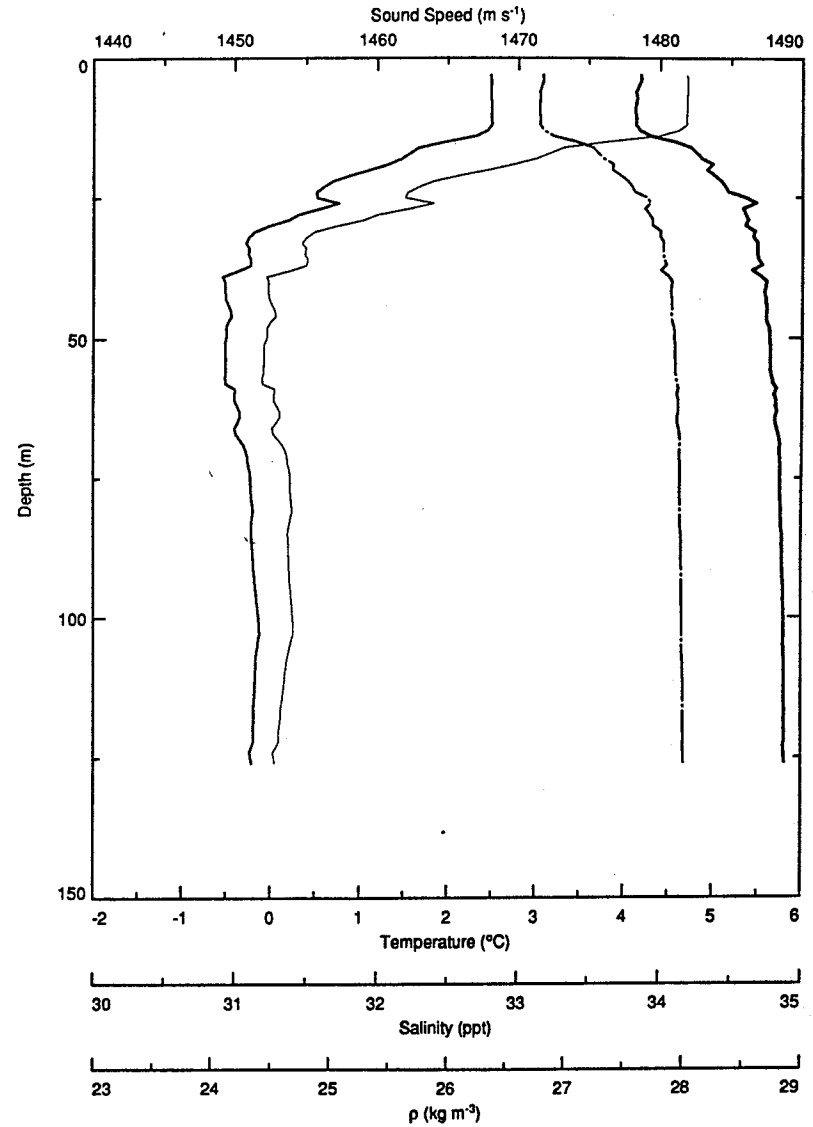
1989 MST : CTD Cast 042



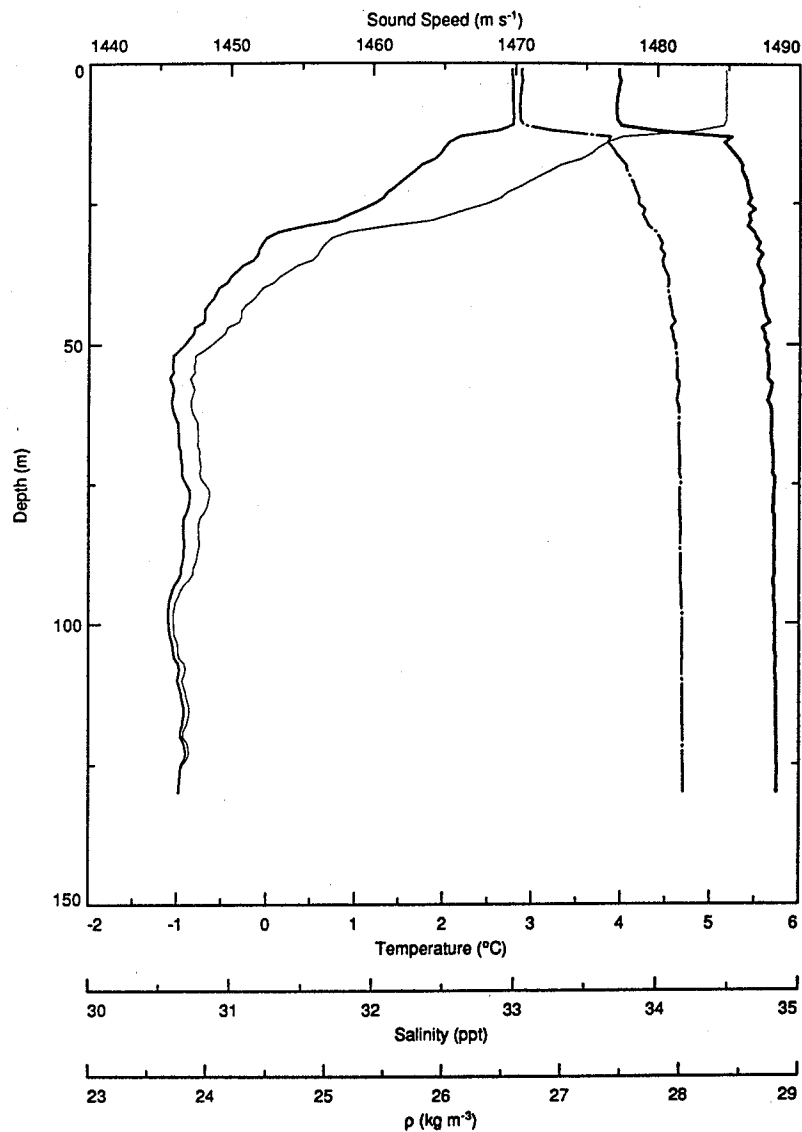
1989 MST : CTD Cast 044



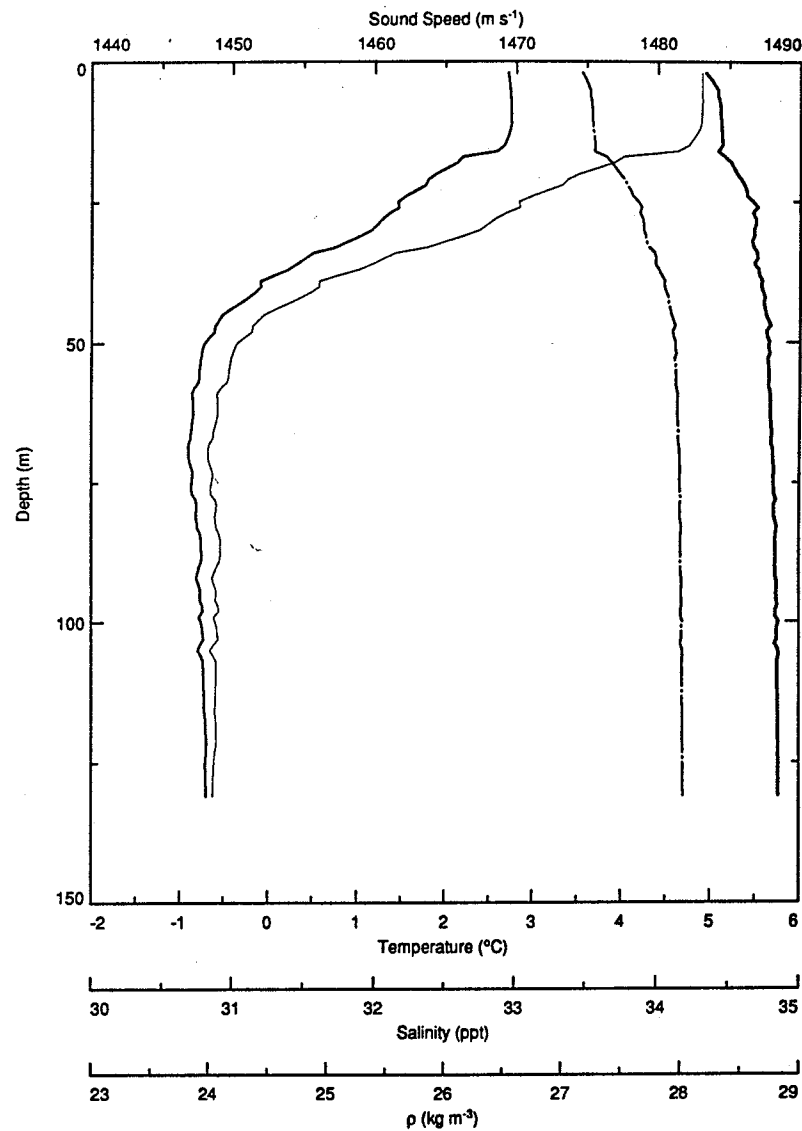
1989 MST : CTD Cast 045



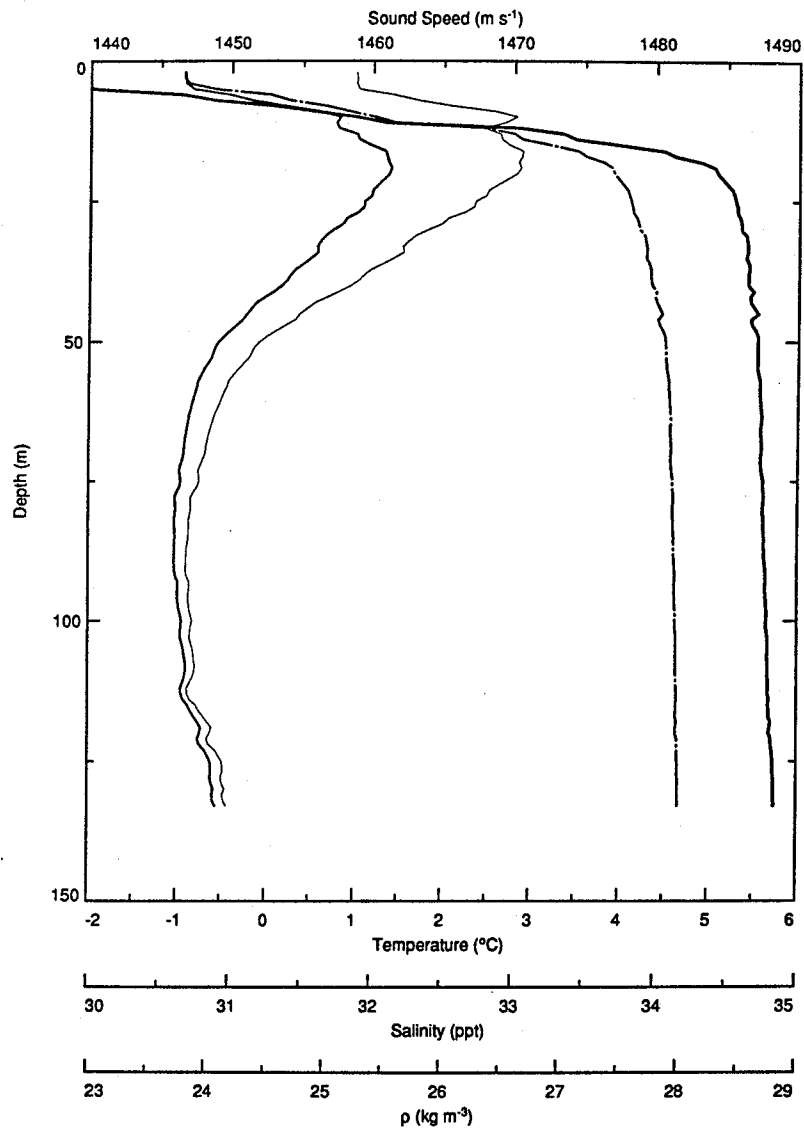
1989 MST : CTD Cast 046



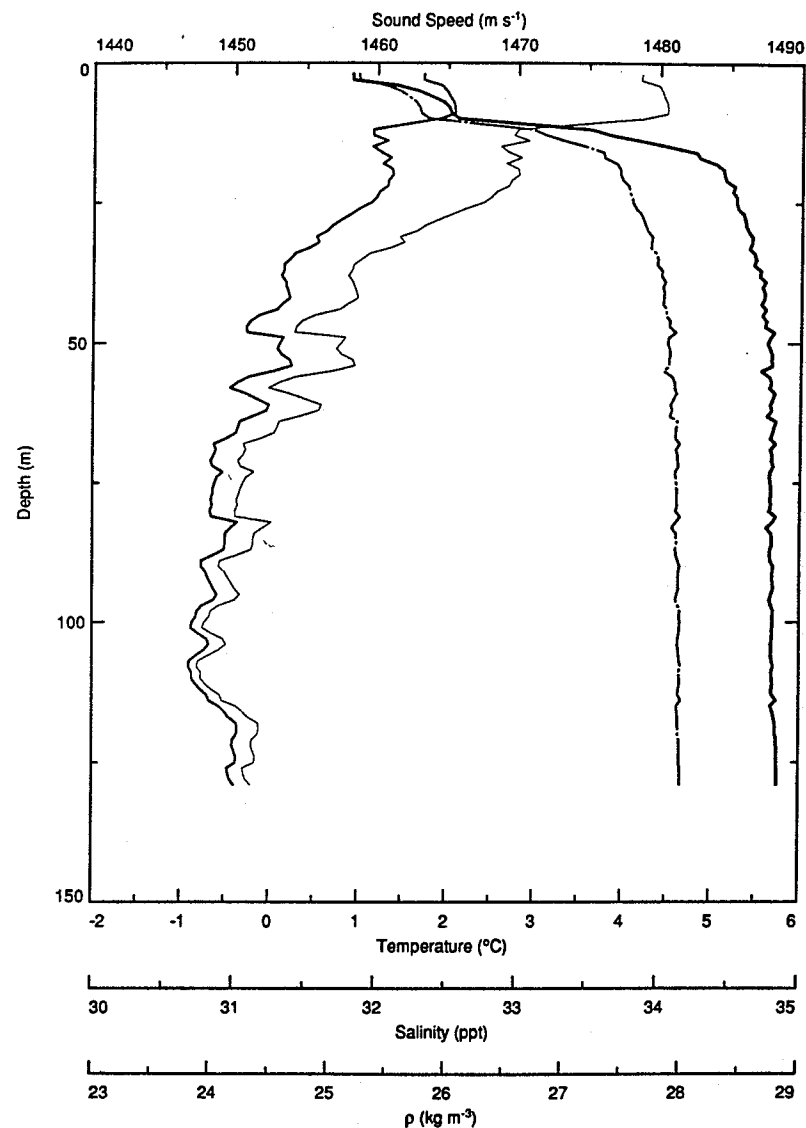
1989 MST : CTD Cast 050



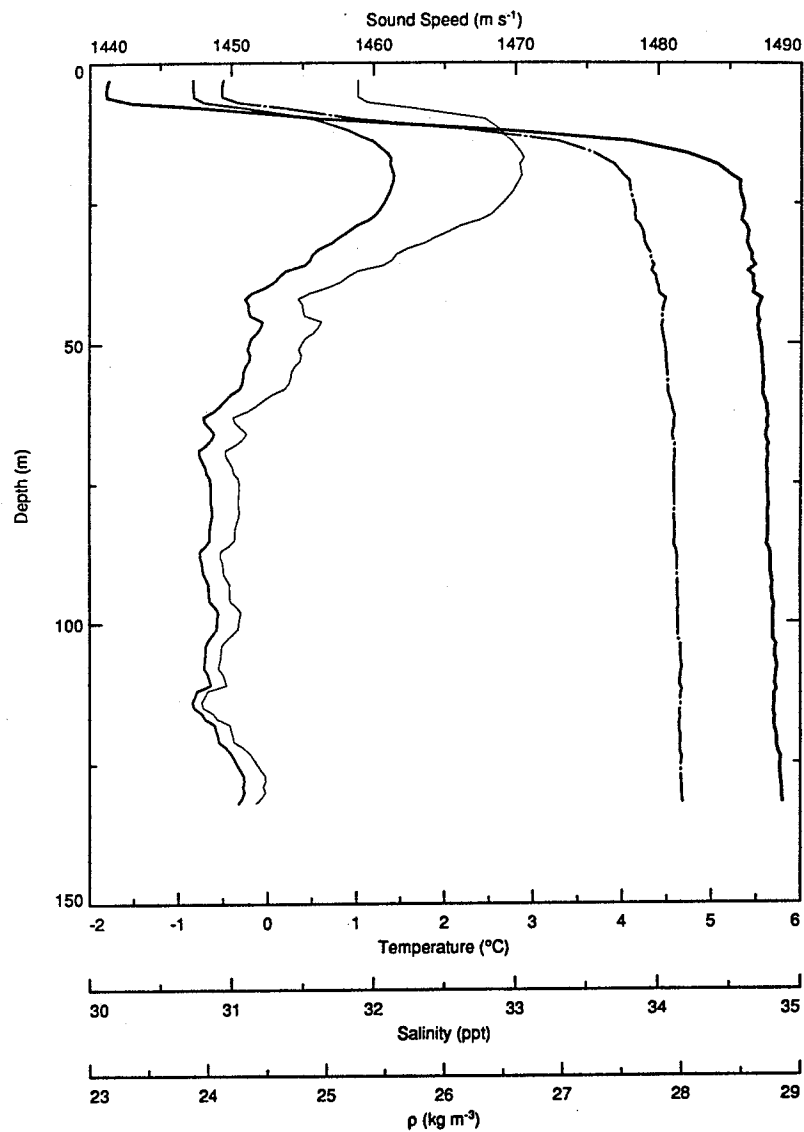
1989 MST : CTD Cast 051



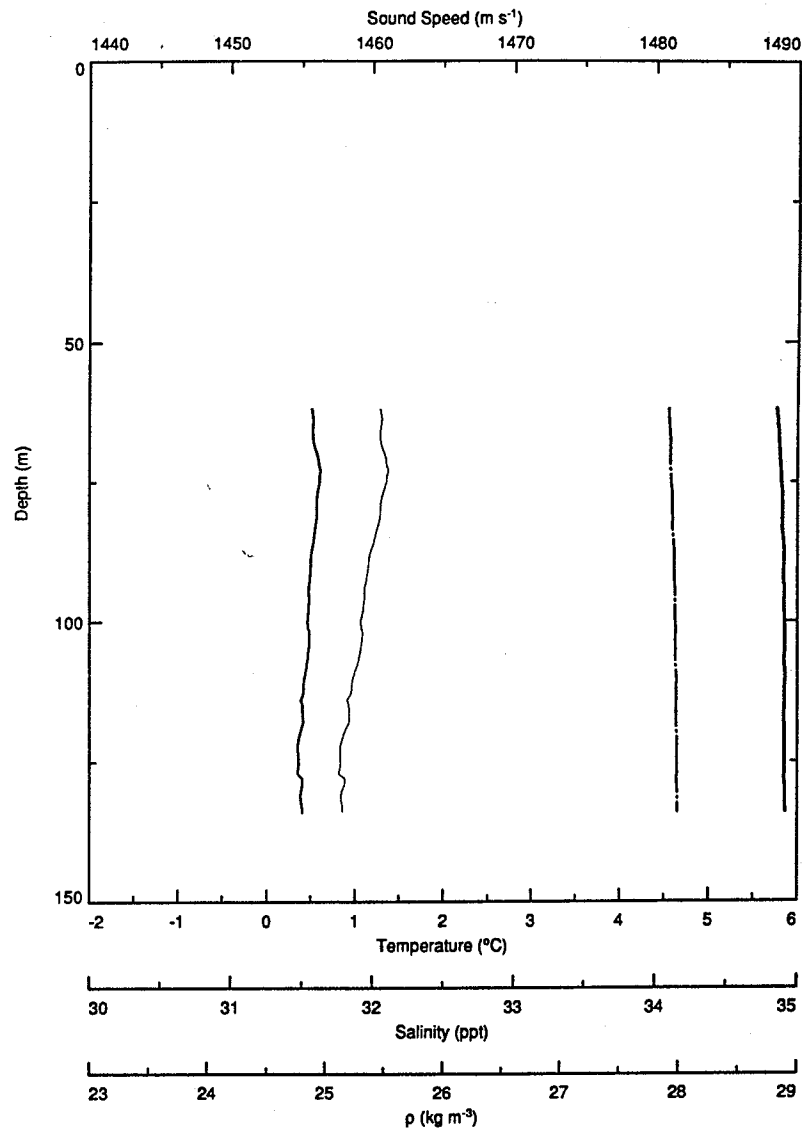
1989 MST : CTD Cast 052



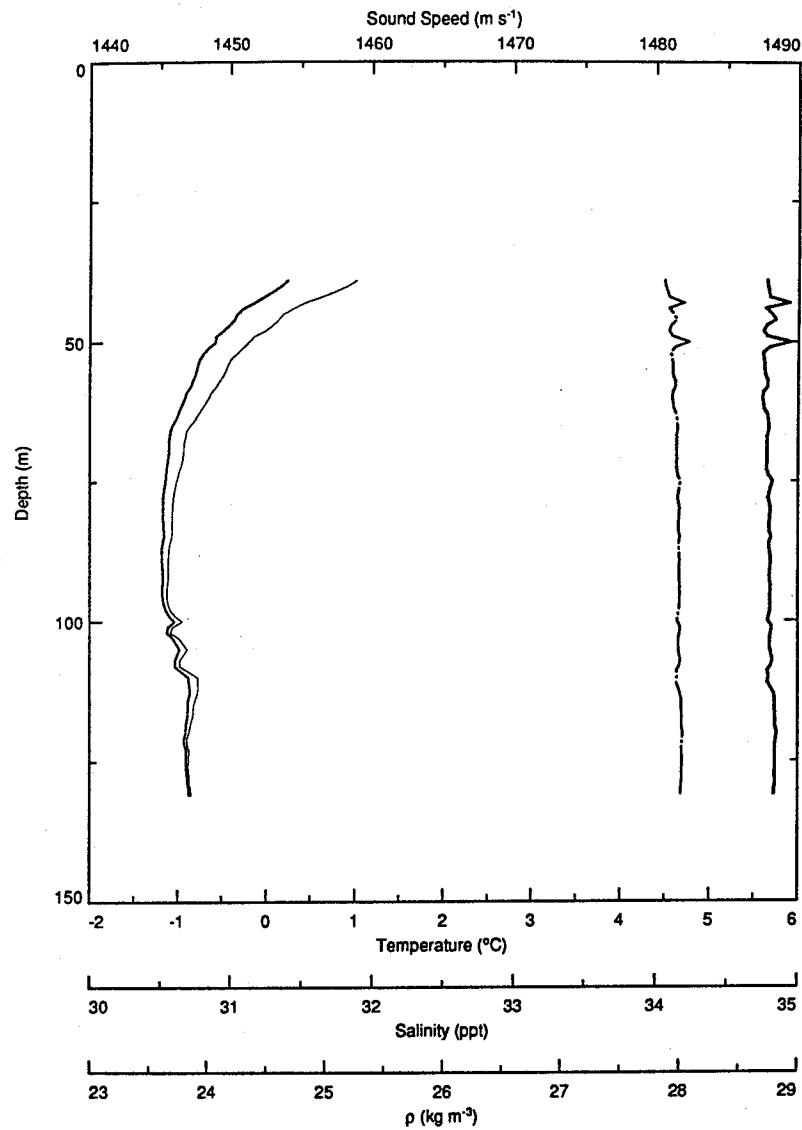
1989 MST : CTD Cast 053



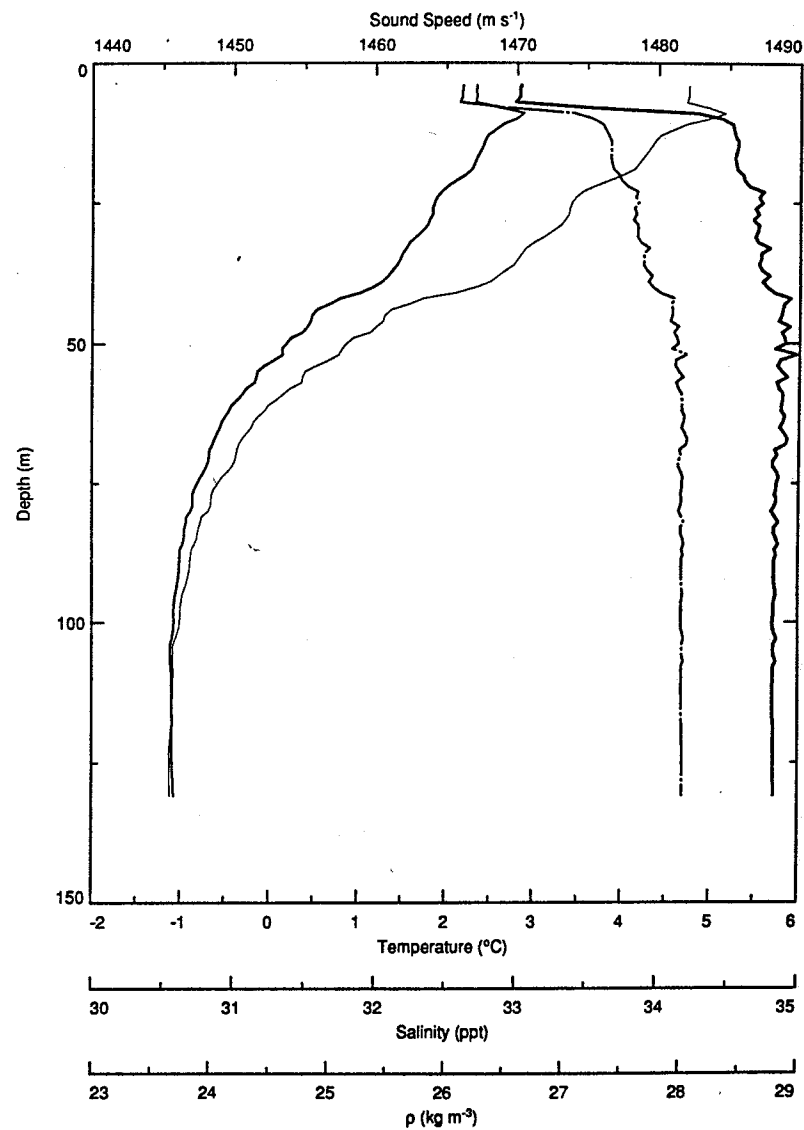
1989 MST : CTD Cast 054



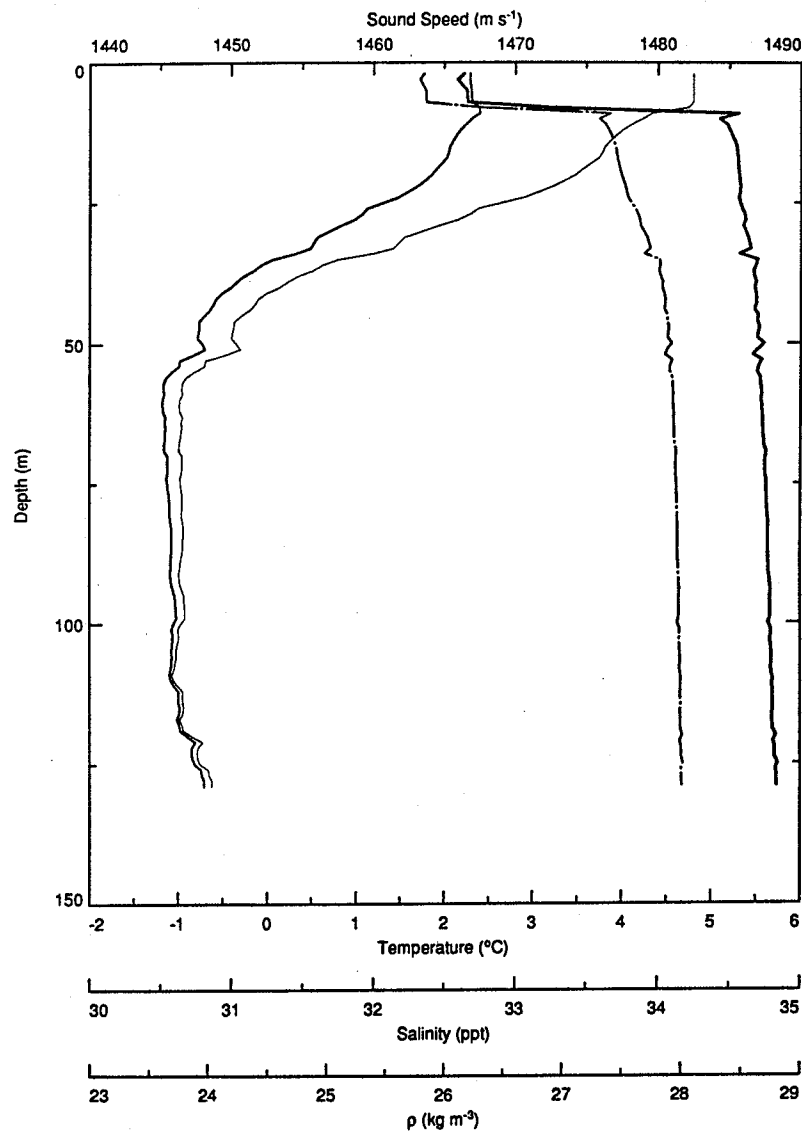
1989 MST : CTD Cast 055



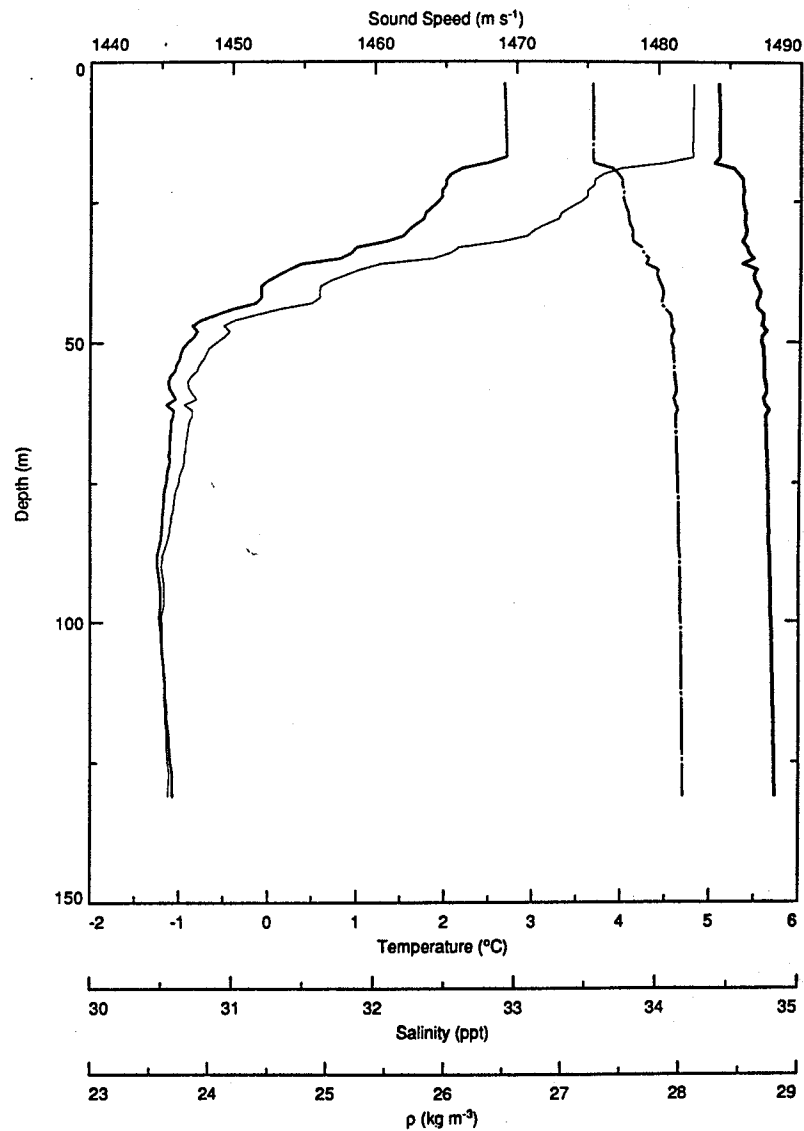
1989 MST : CTD Cast 056



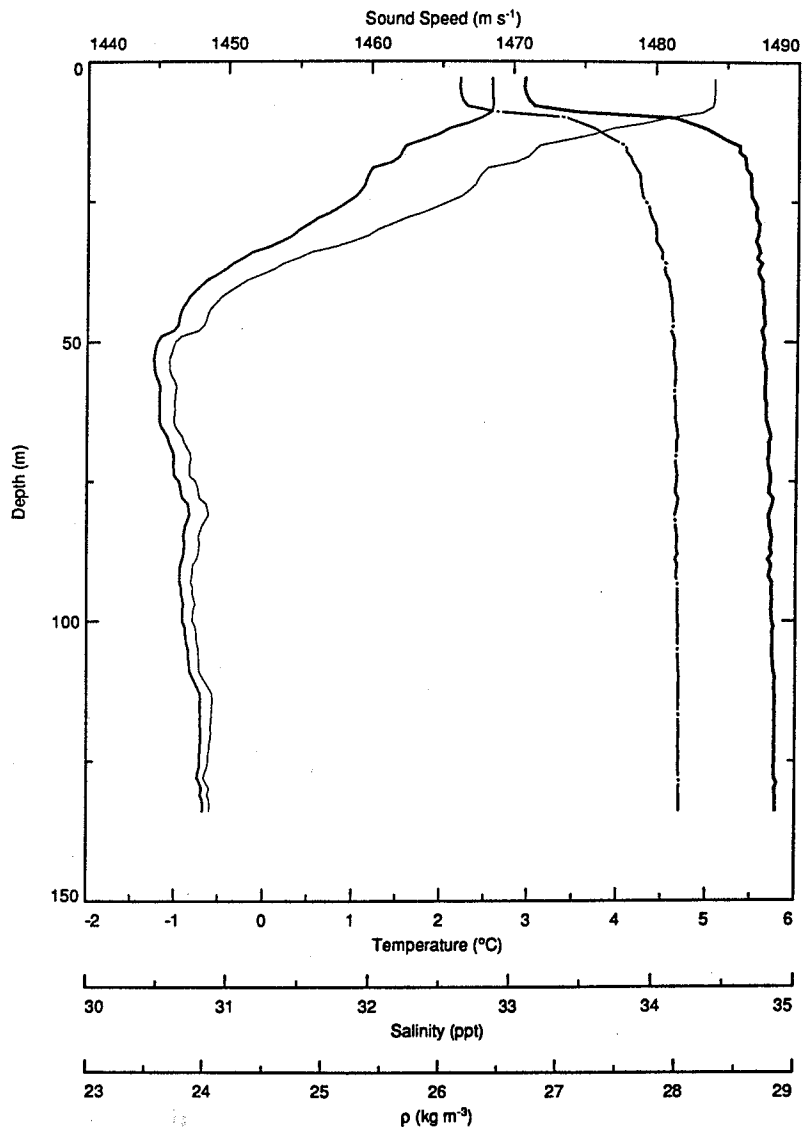
1989 MST : CTD Cast 058



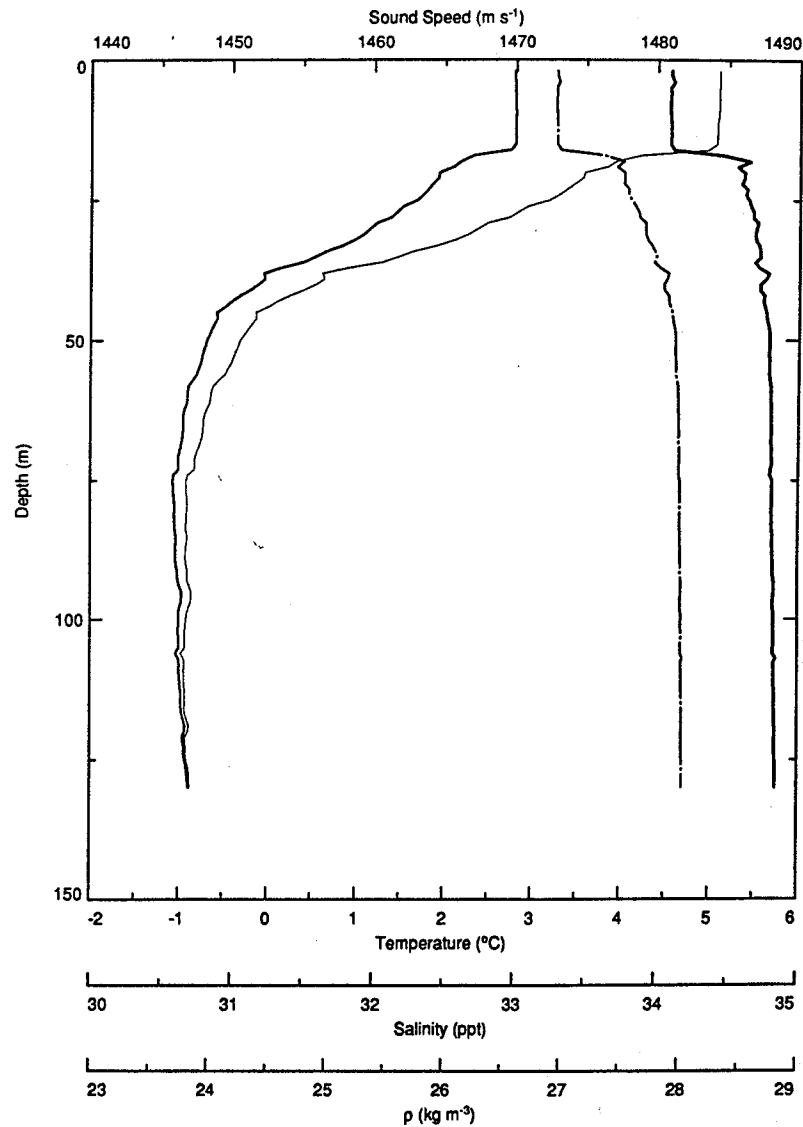
1989 MST : CTD Cast 059



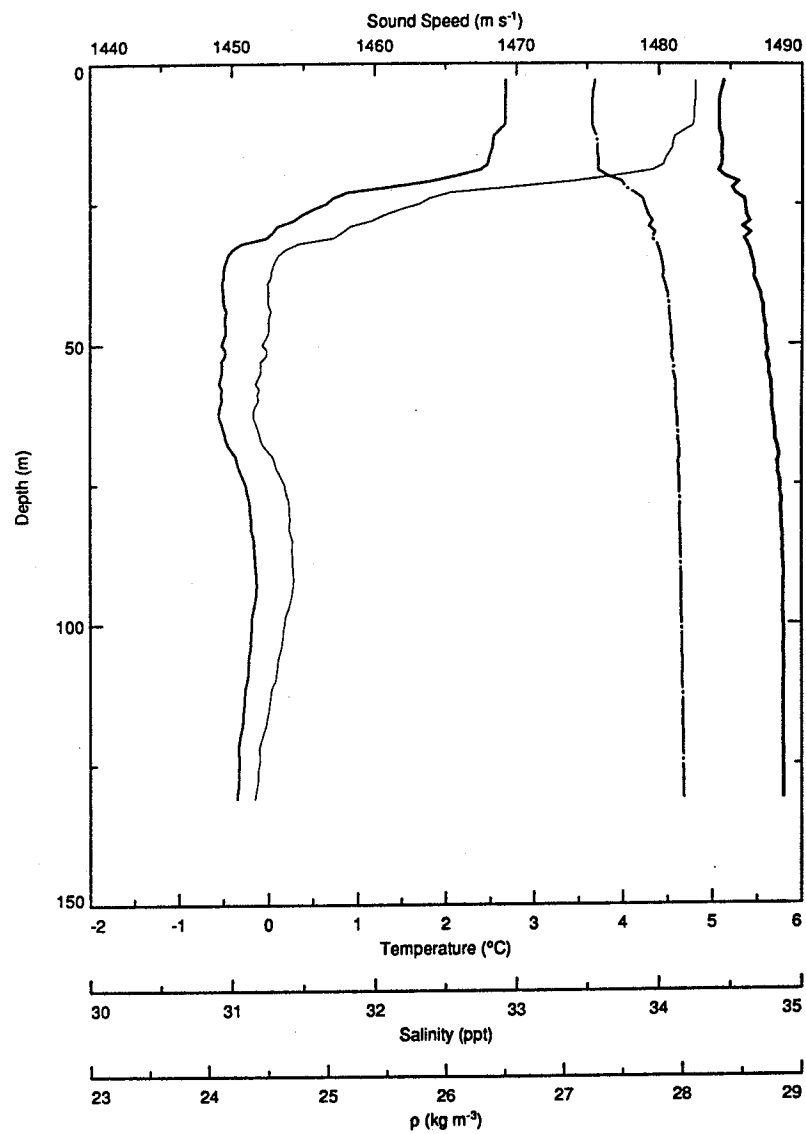
1989 MST : CTD Cast 061



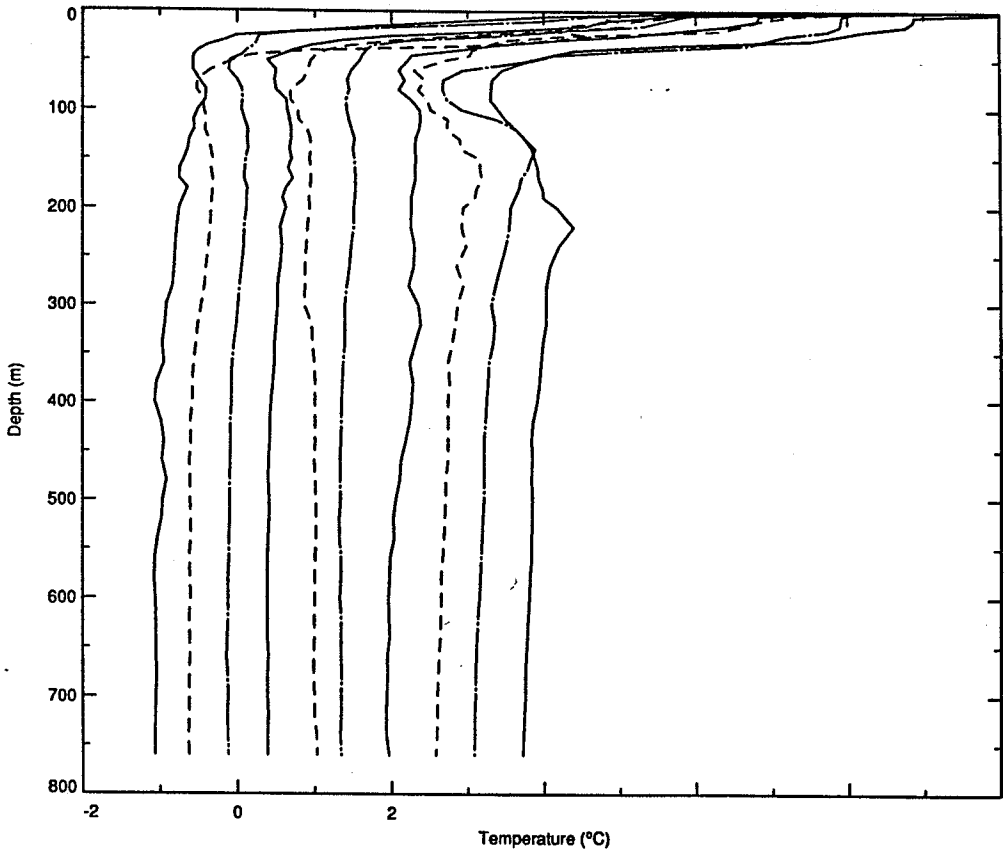
1989 MST : CTD Cast 063



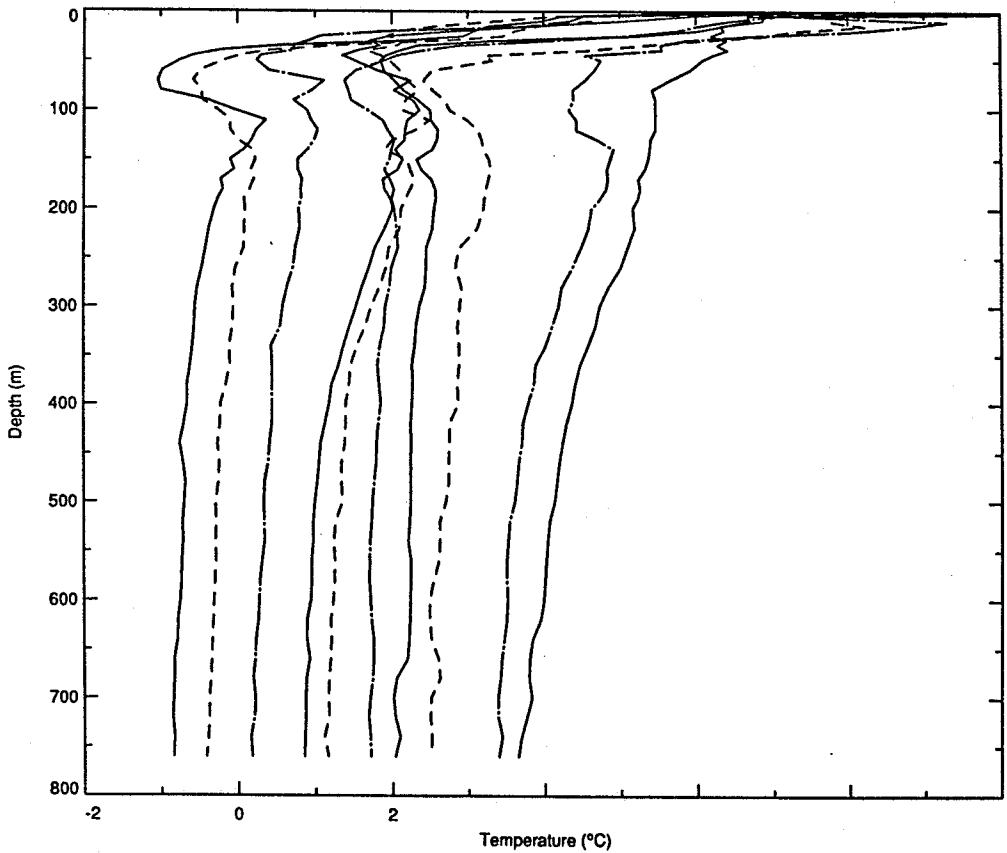
1989 MST : CTD Cast 064



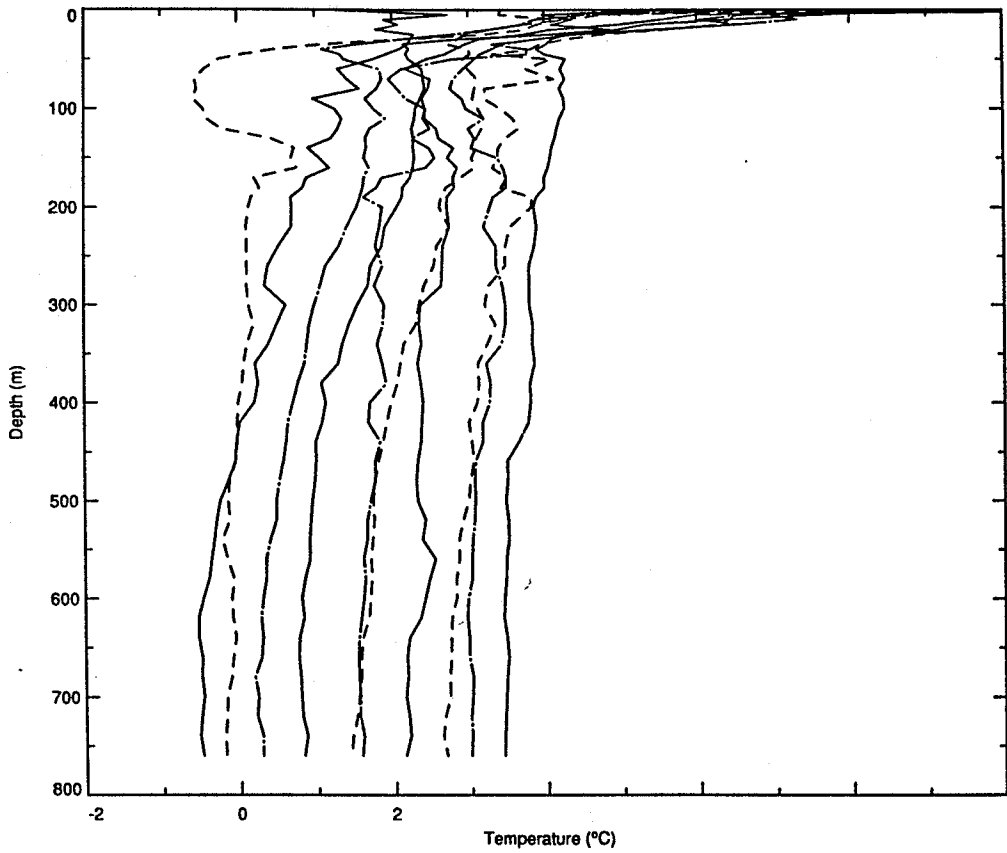
MST89 XBT Drops 1-10



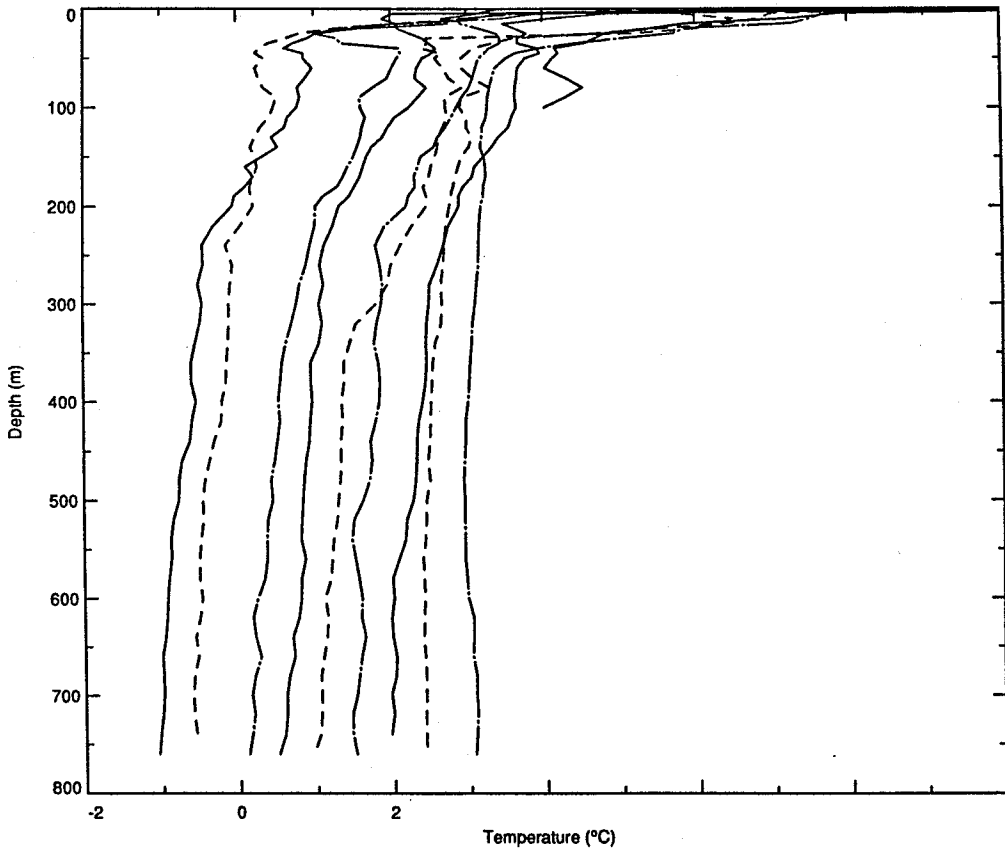
MST89 XBT Drops 11-20



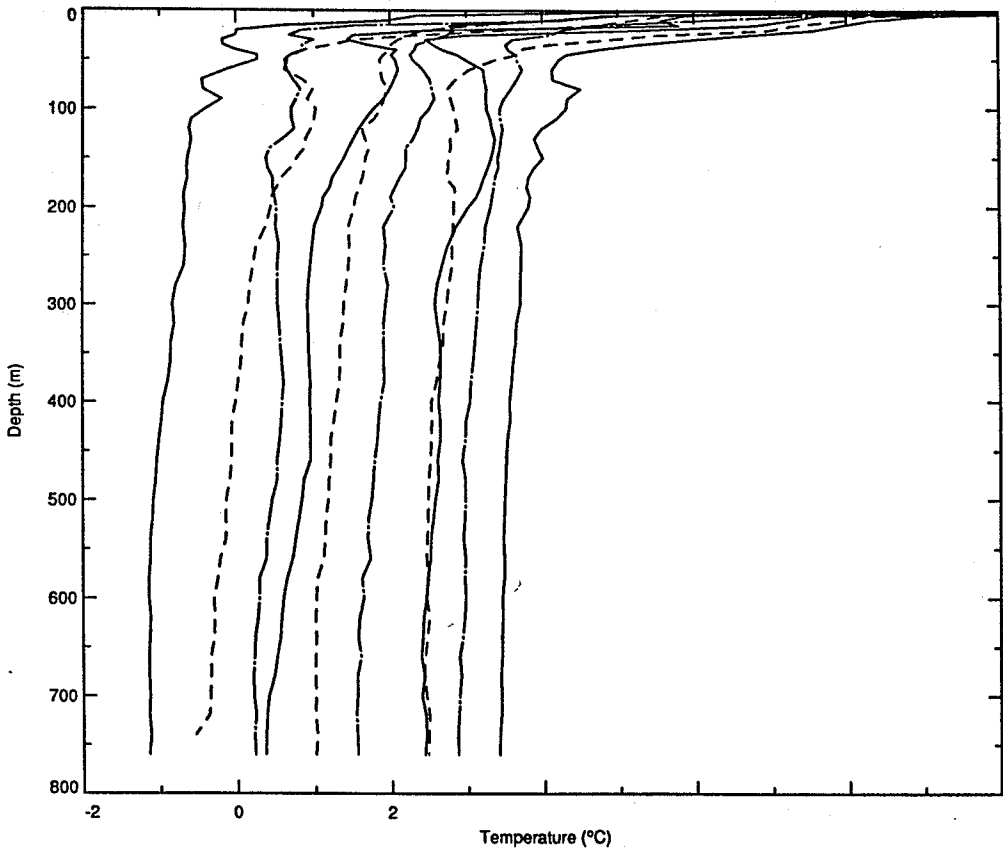
MST89 XBT Drops 21-30



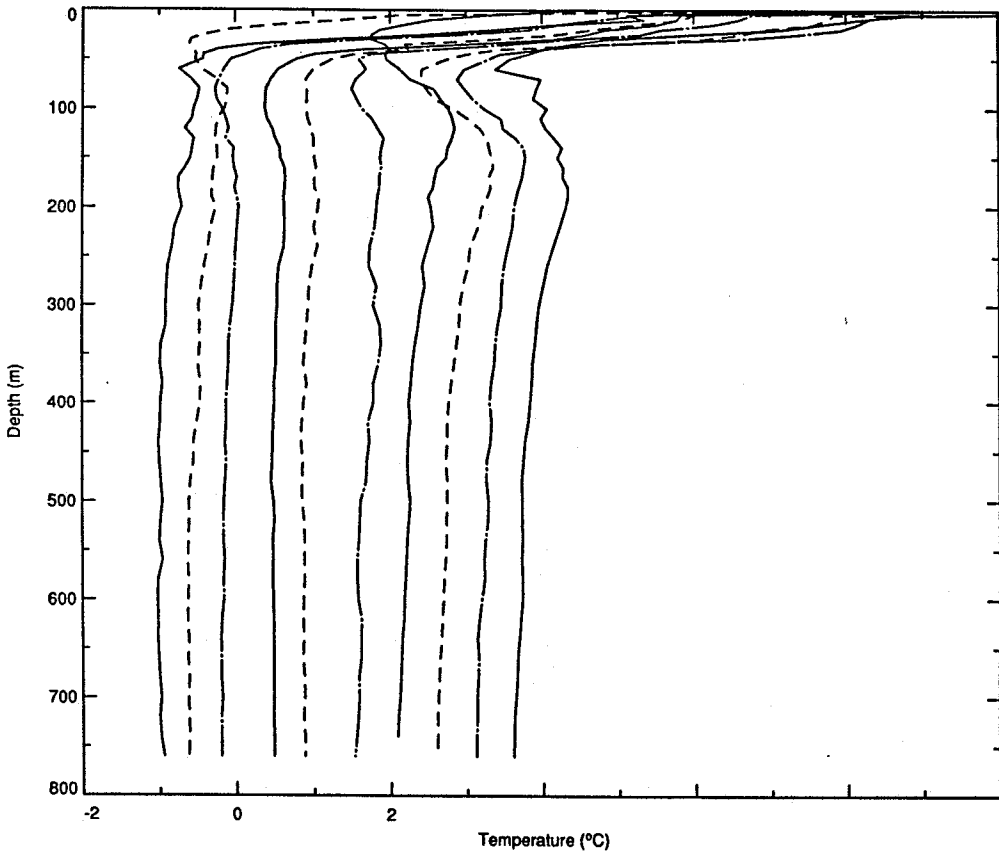
MST89 XBT Drops 31-40



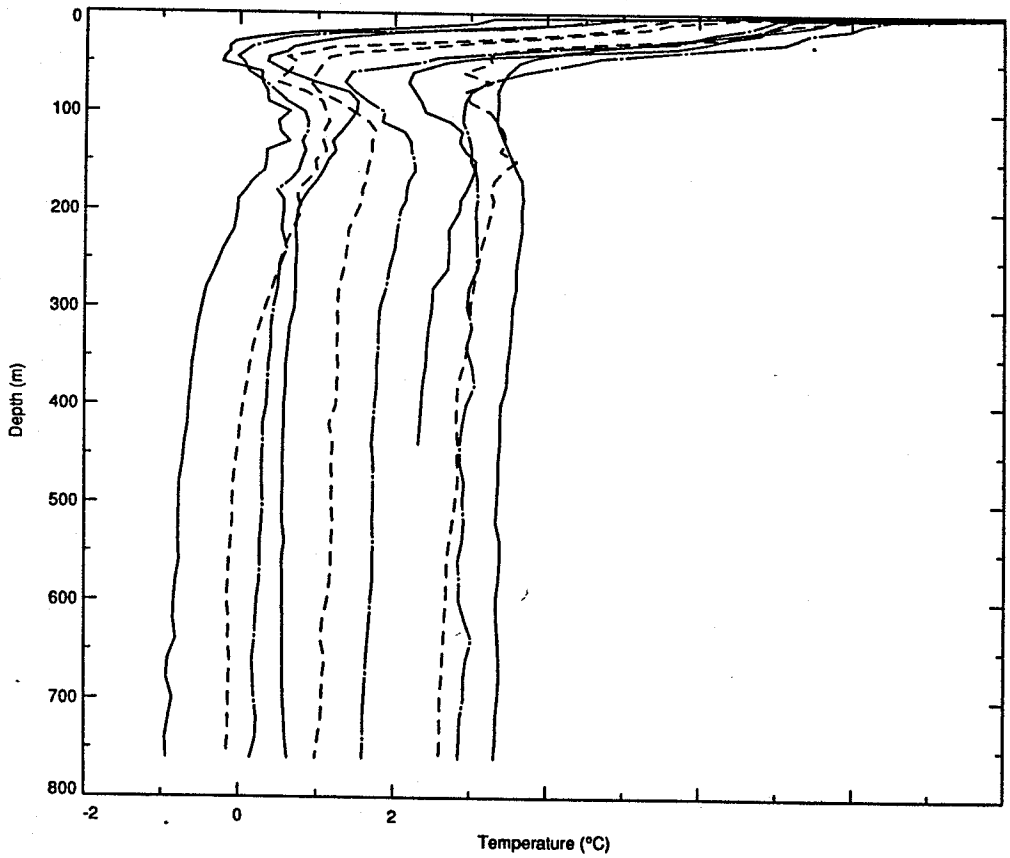
MST89 XBT Drops 41-50



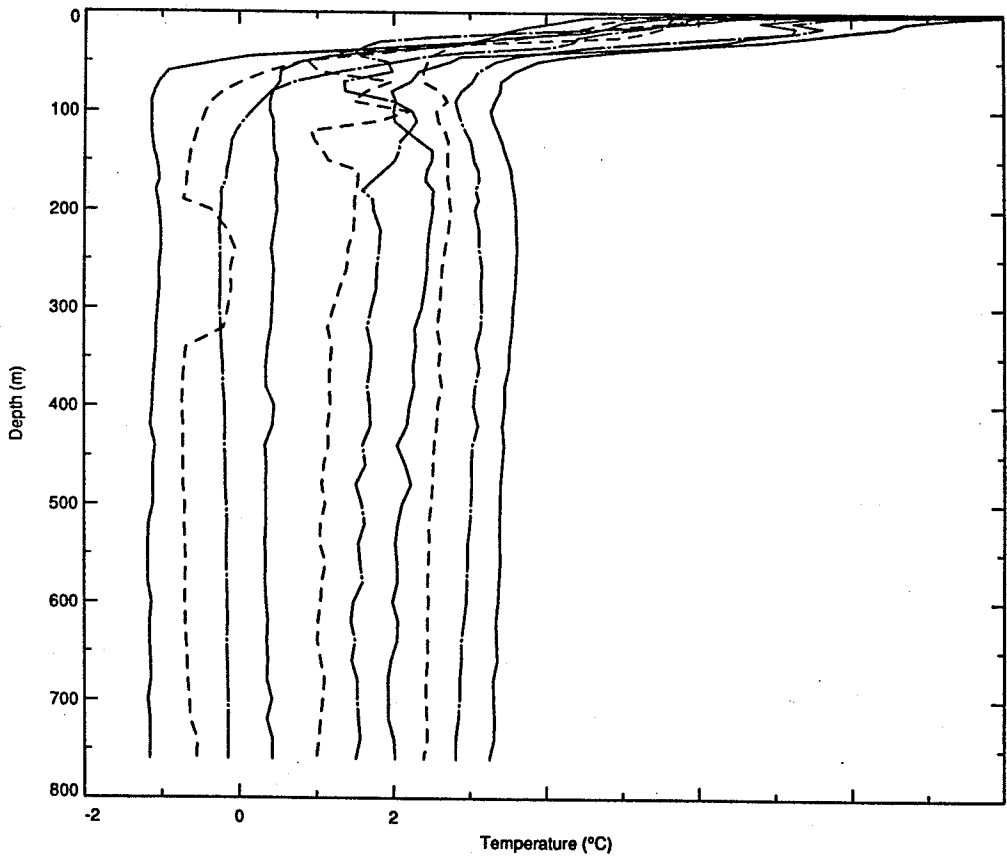
MST89 XBT Drops 51-60



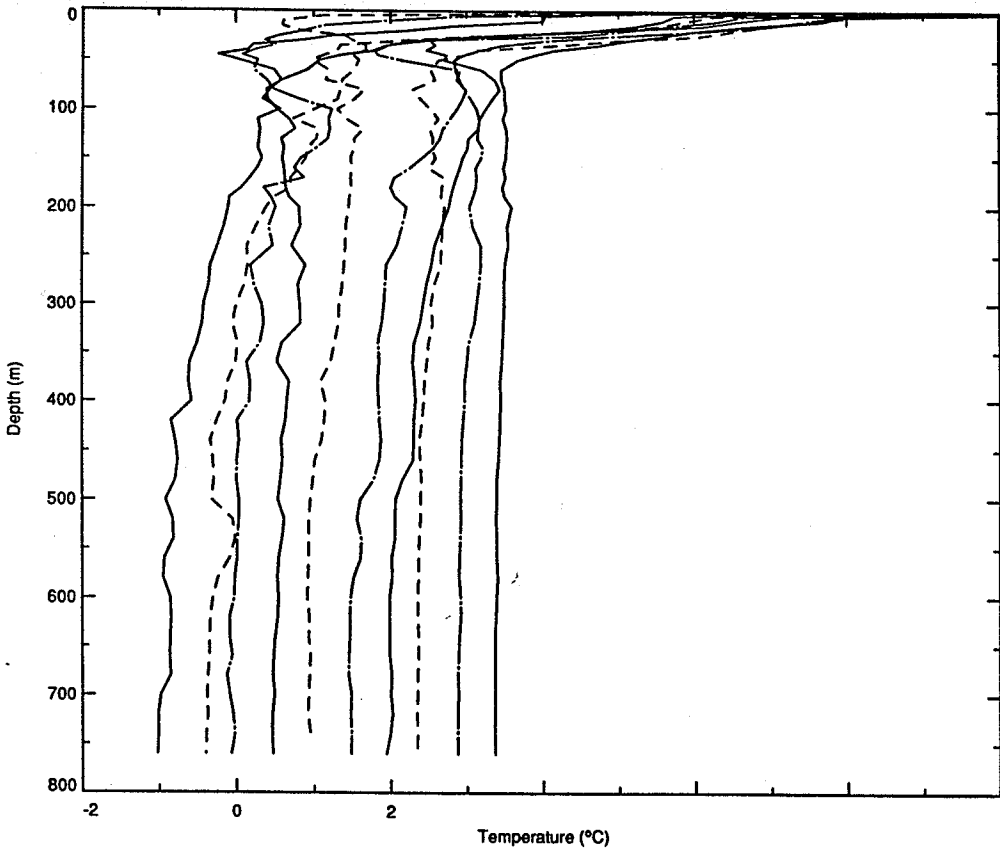
MST89 XBT Drops 61-70



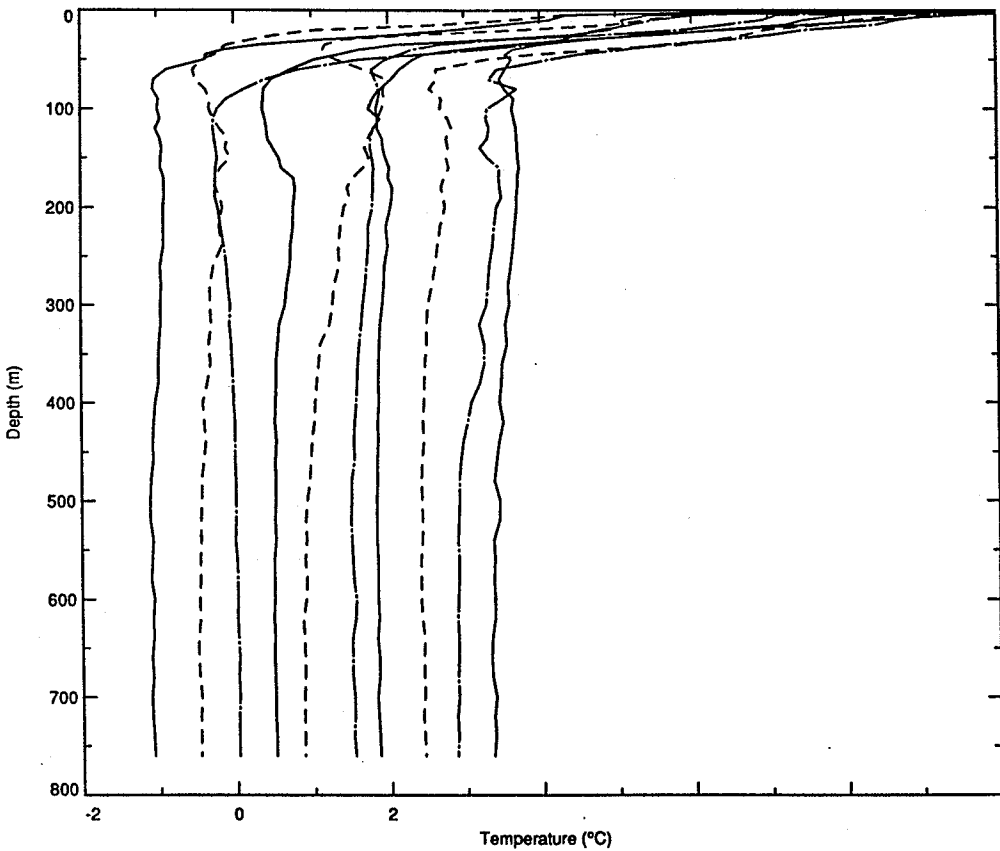
MST89 XBT Drops 71-80



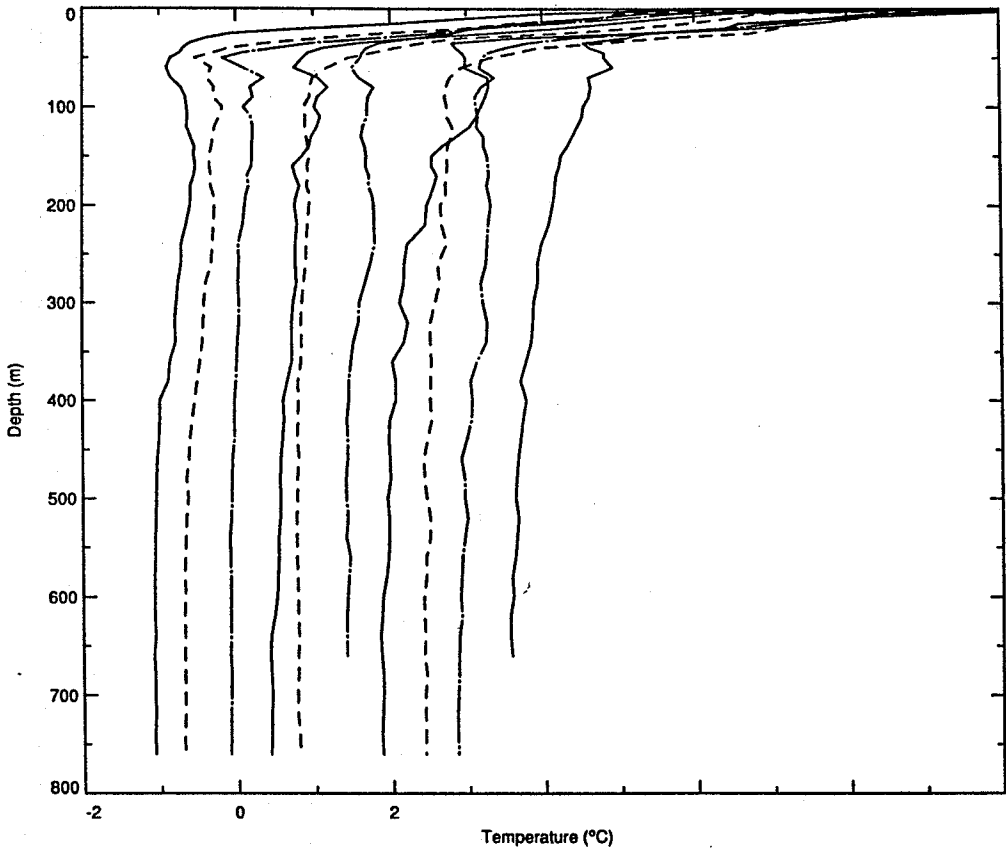
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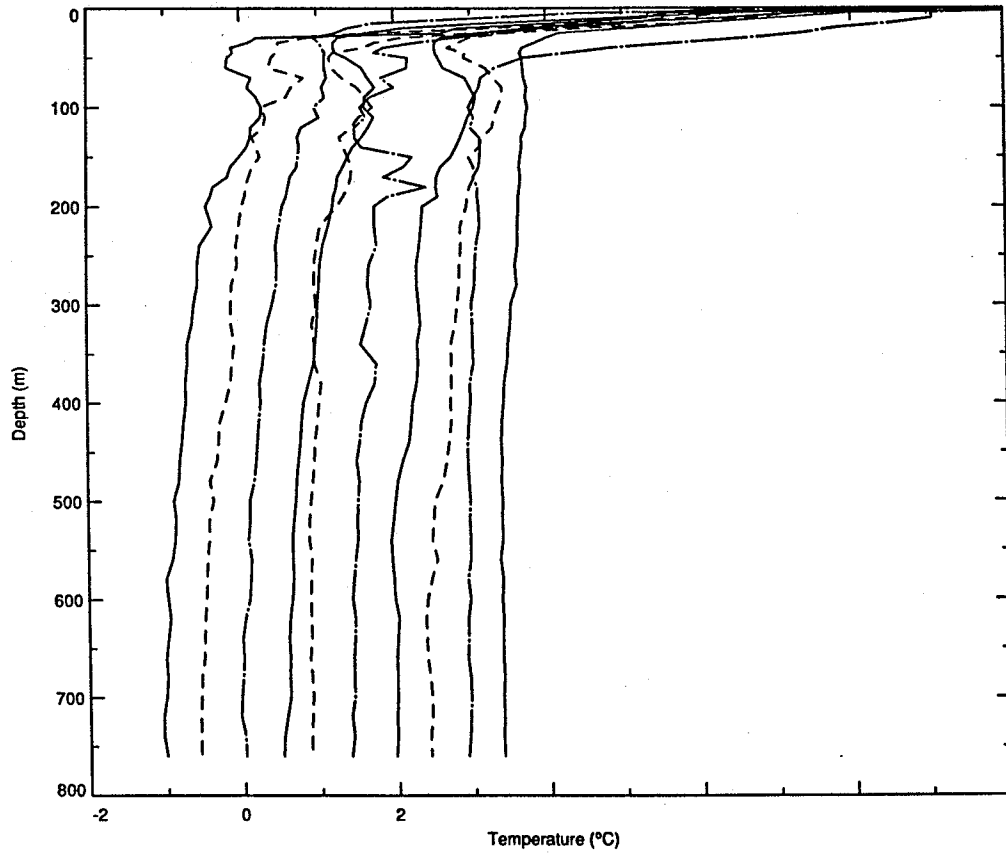
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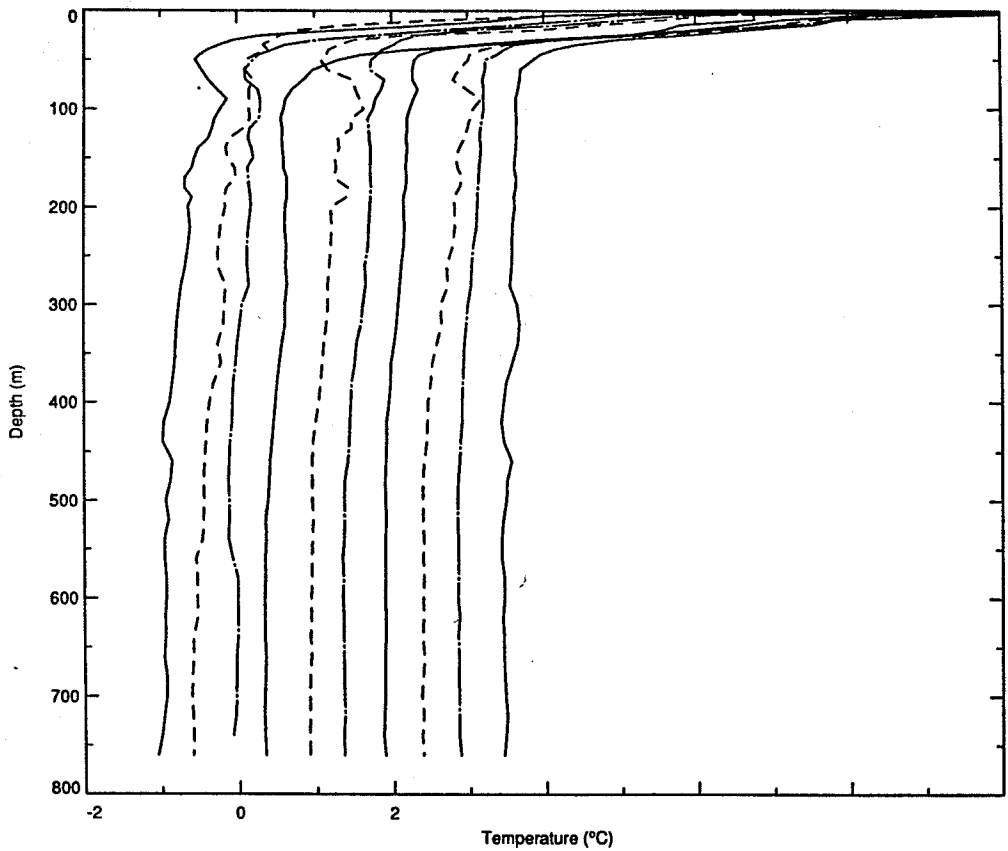
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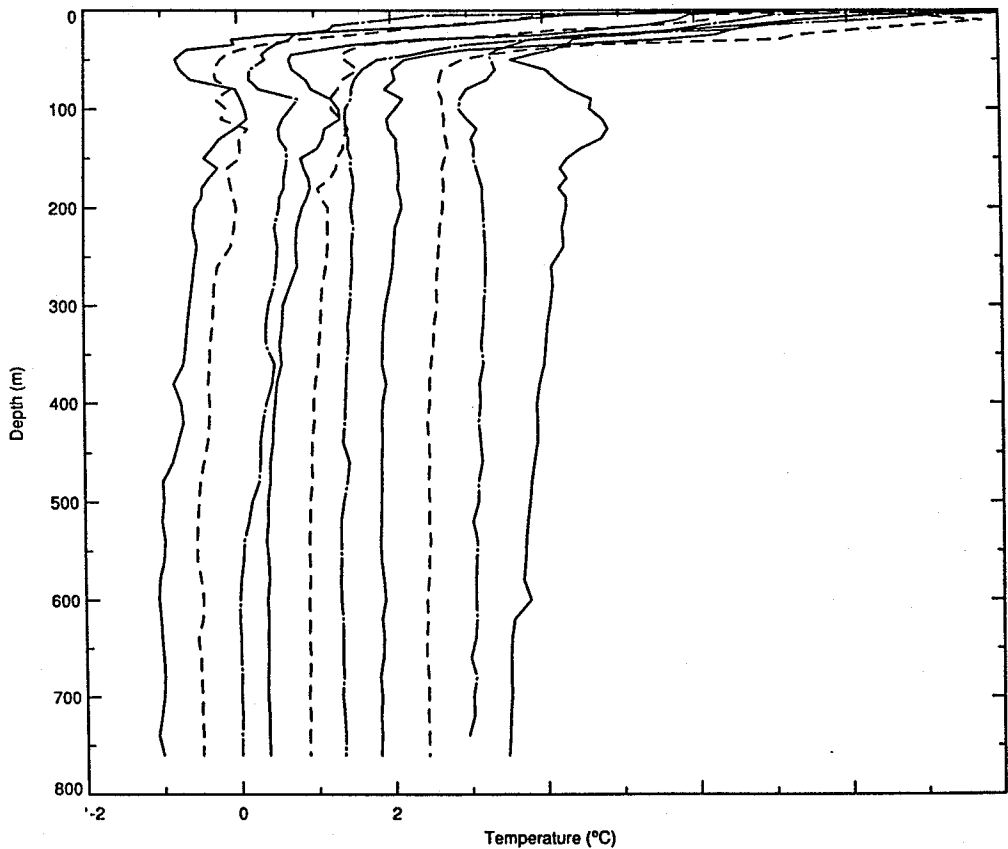
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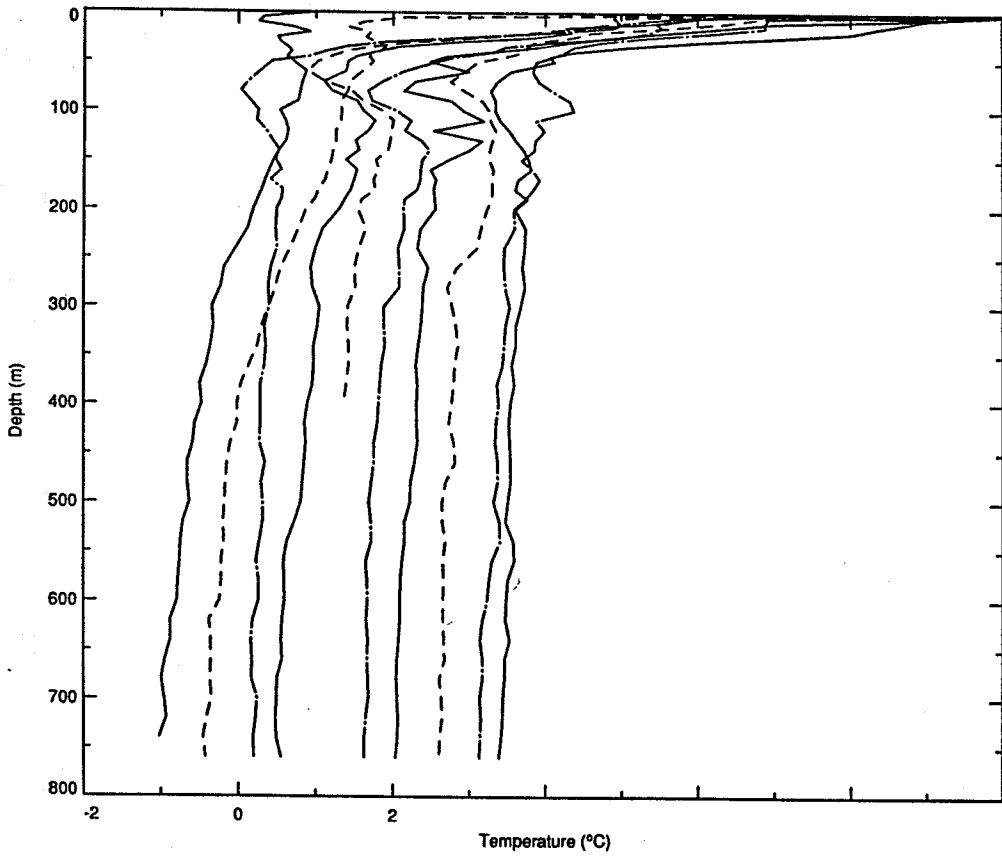
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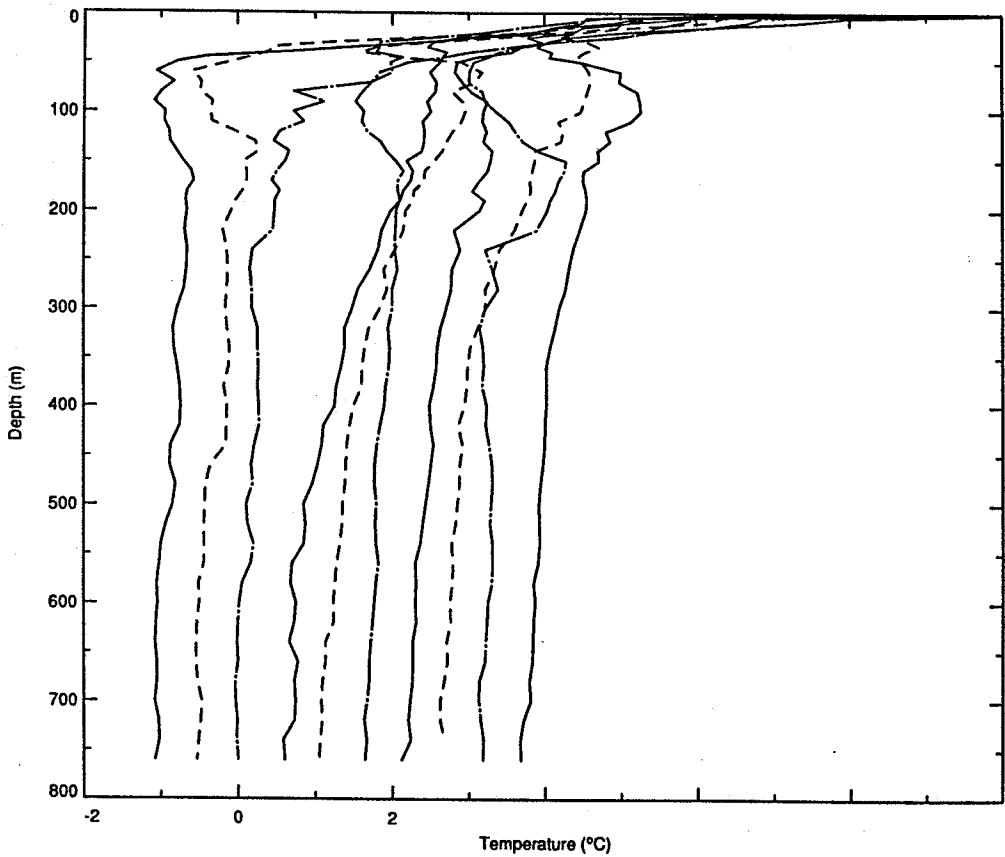
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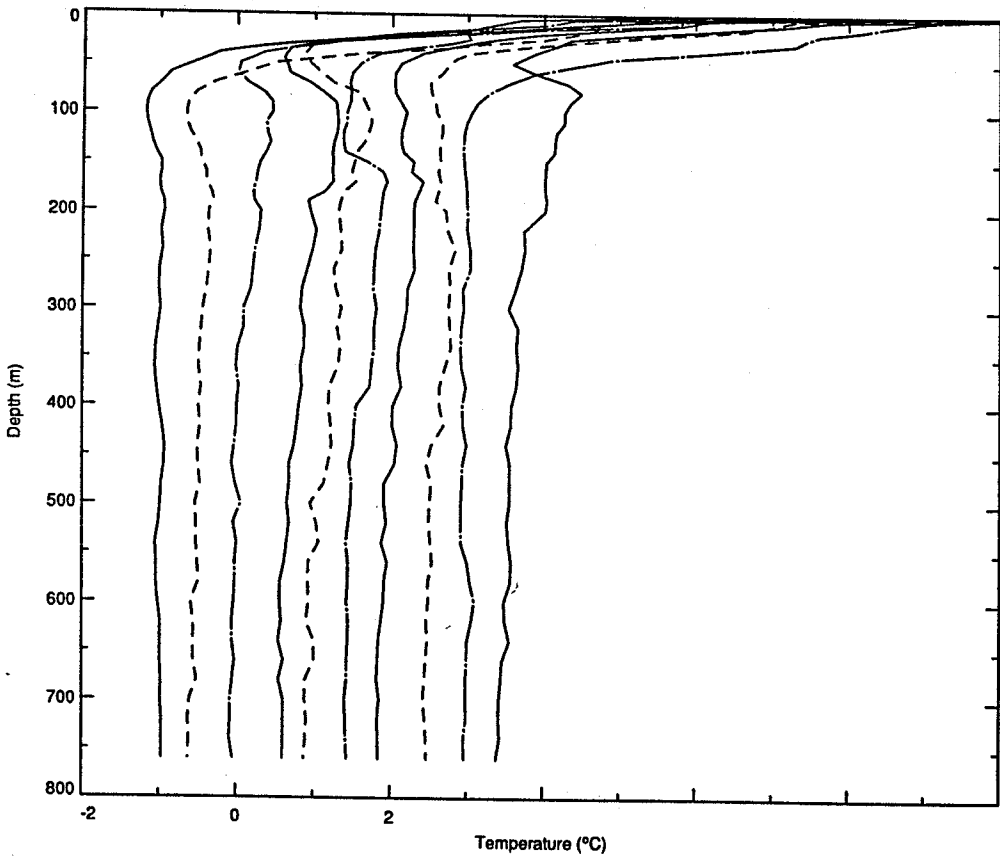
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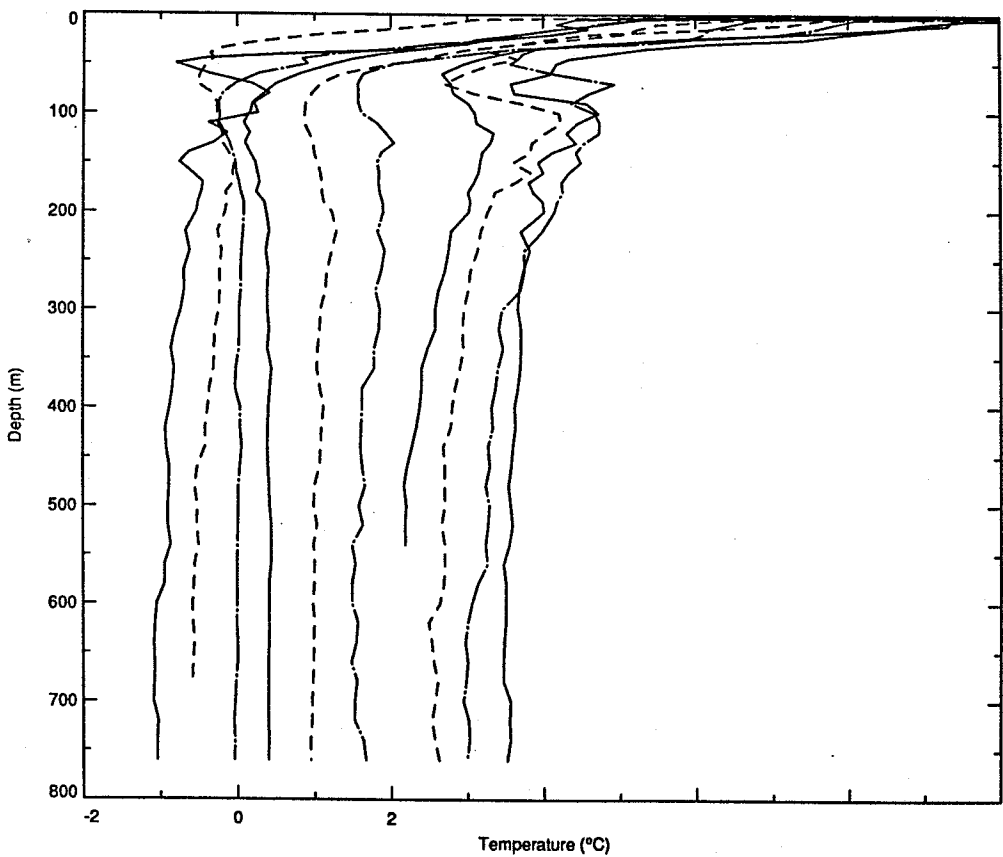
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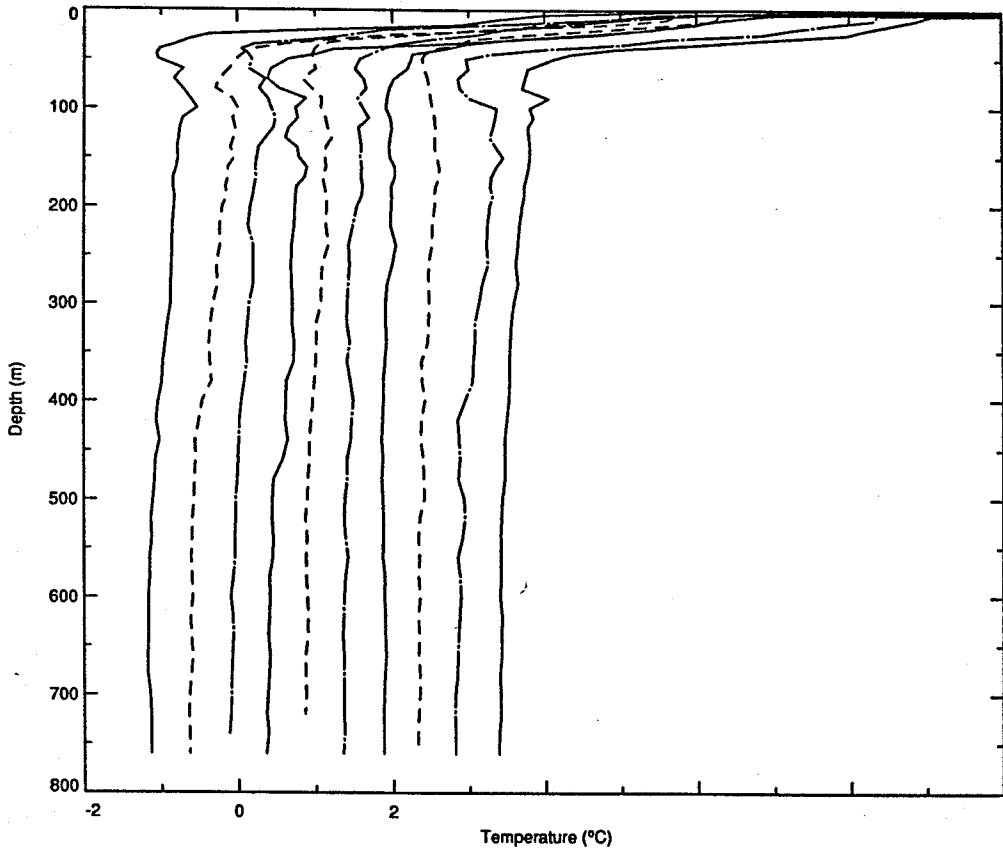
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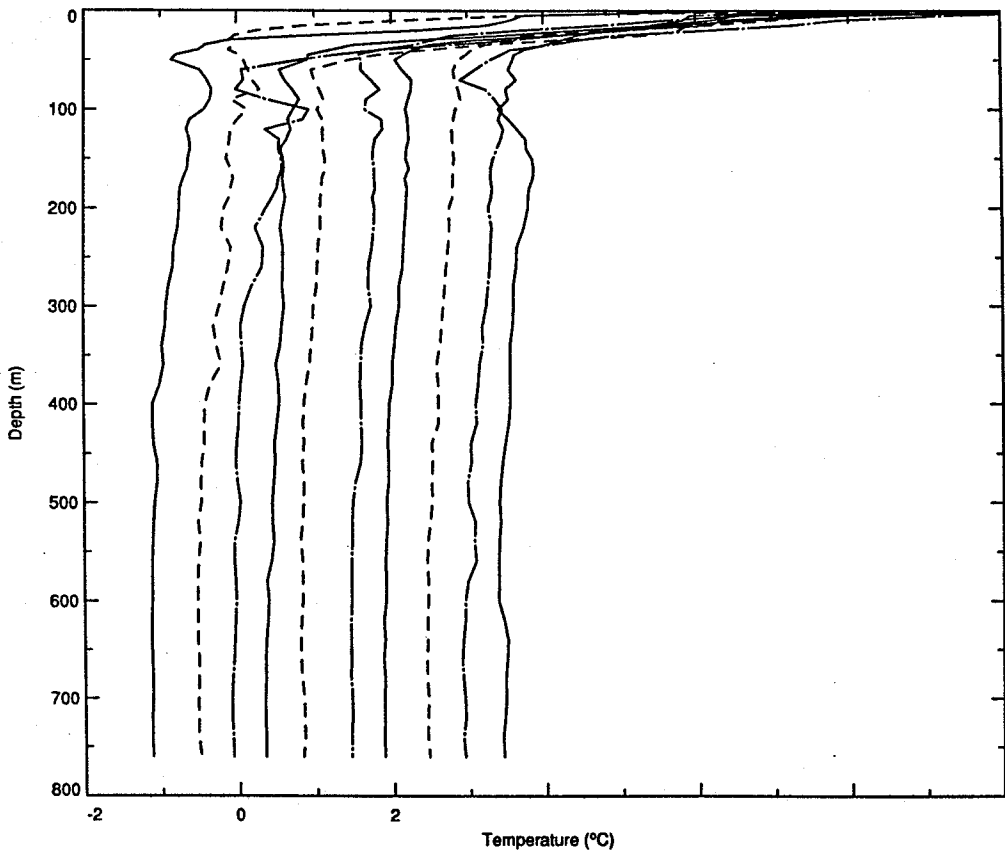
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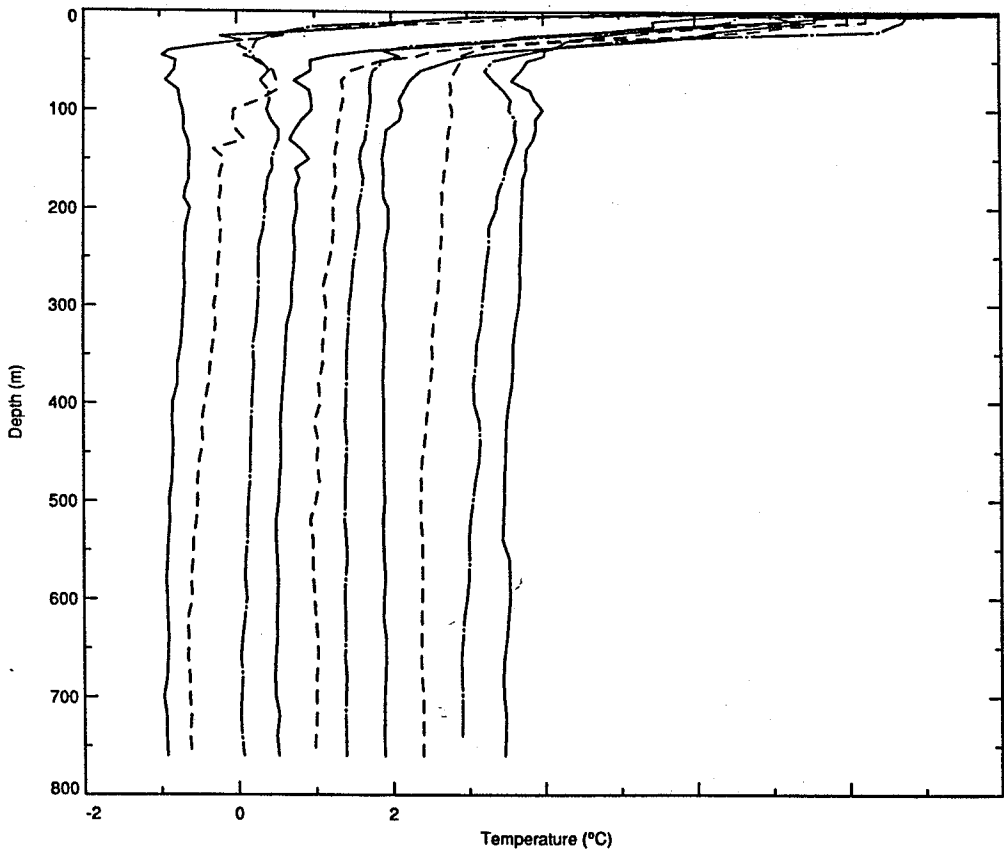
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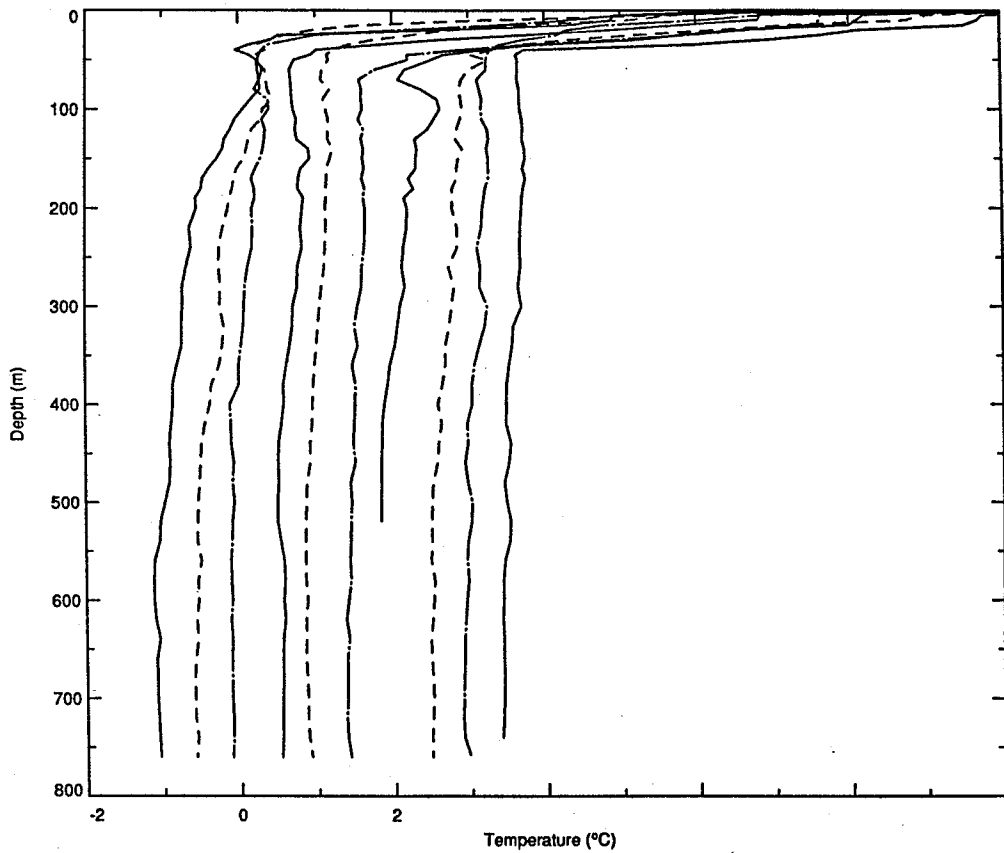
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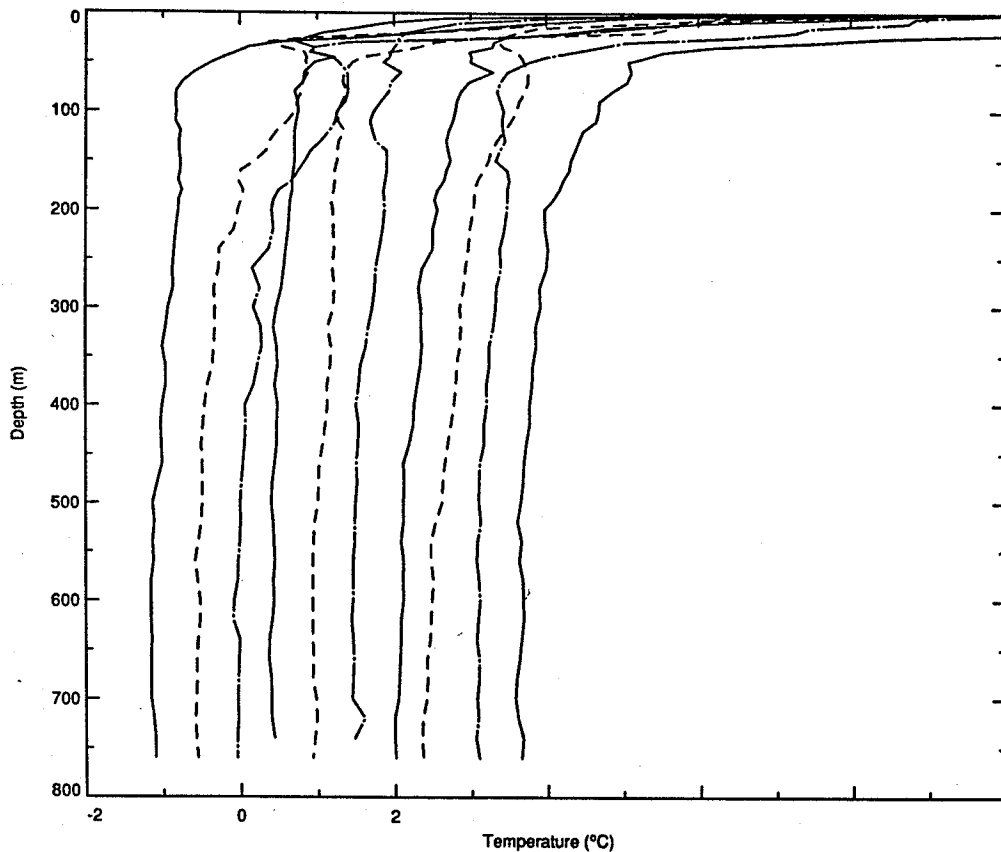
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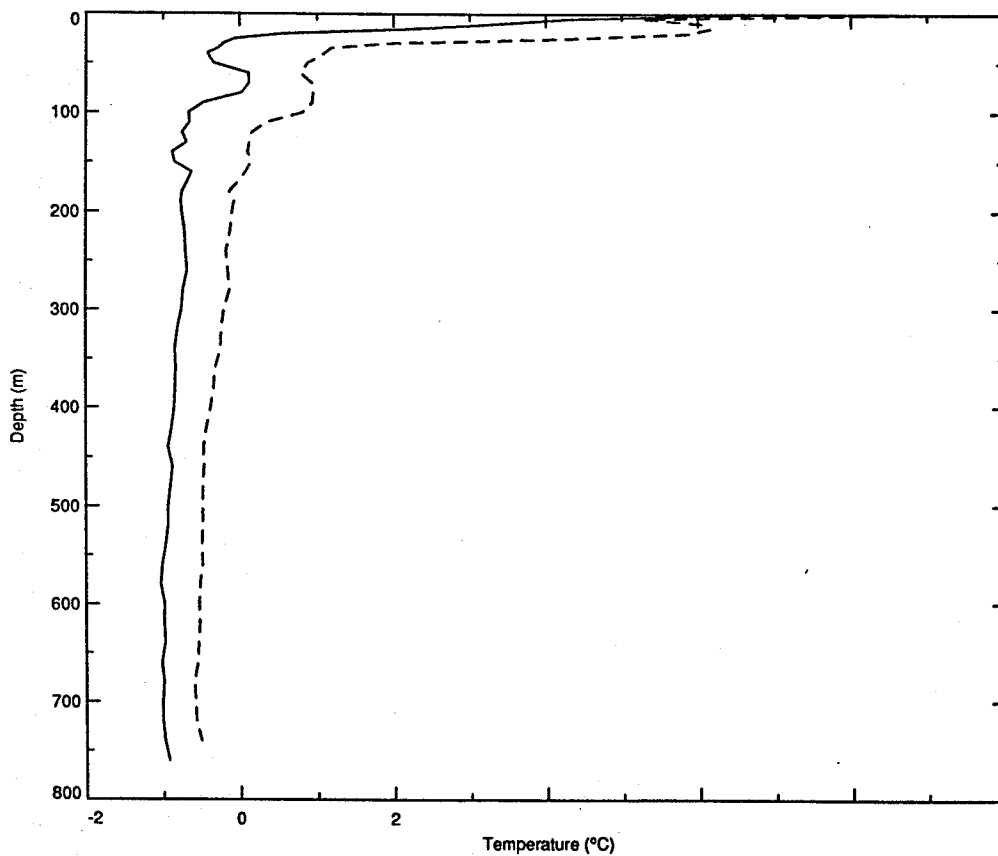
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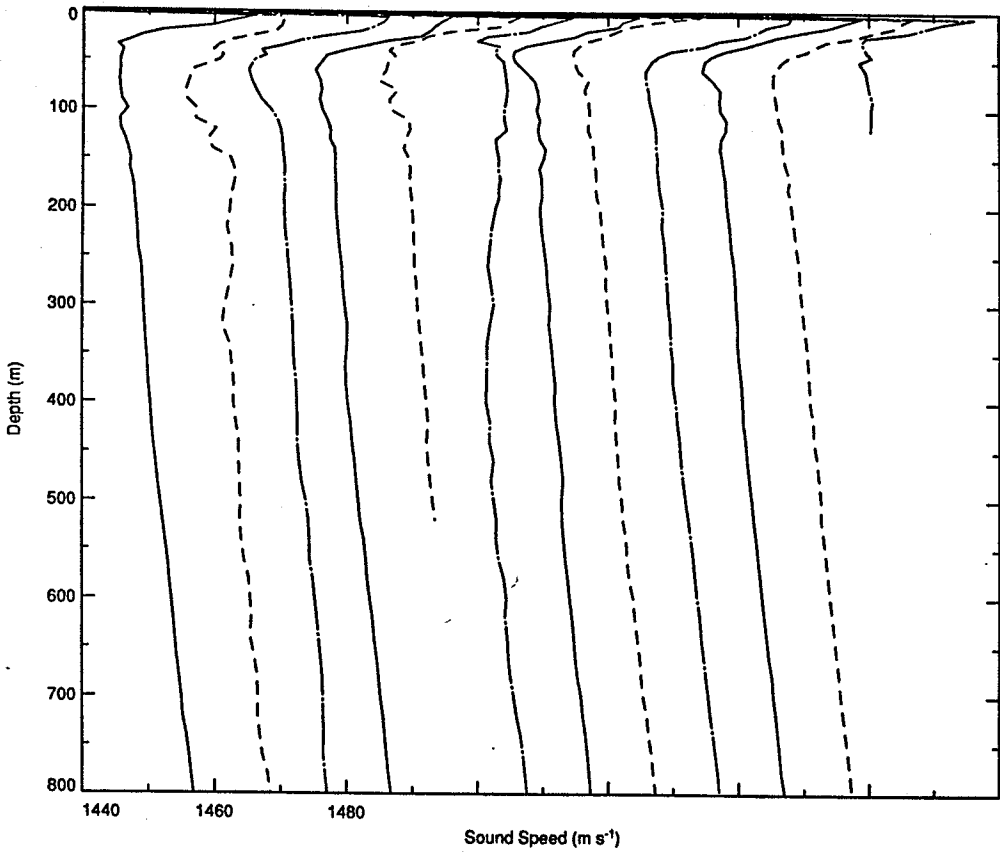
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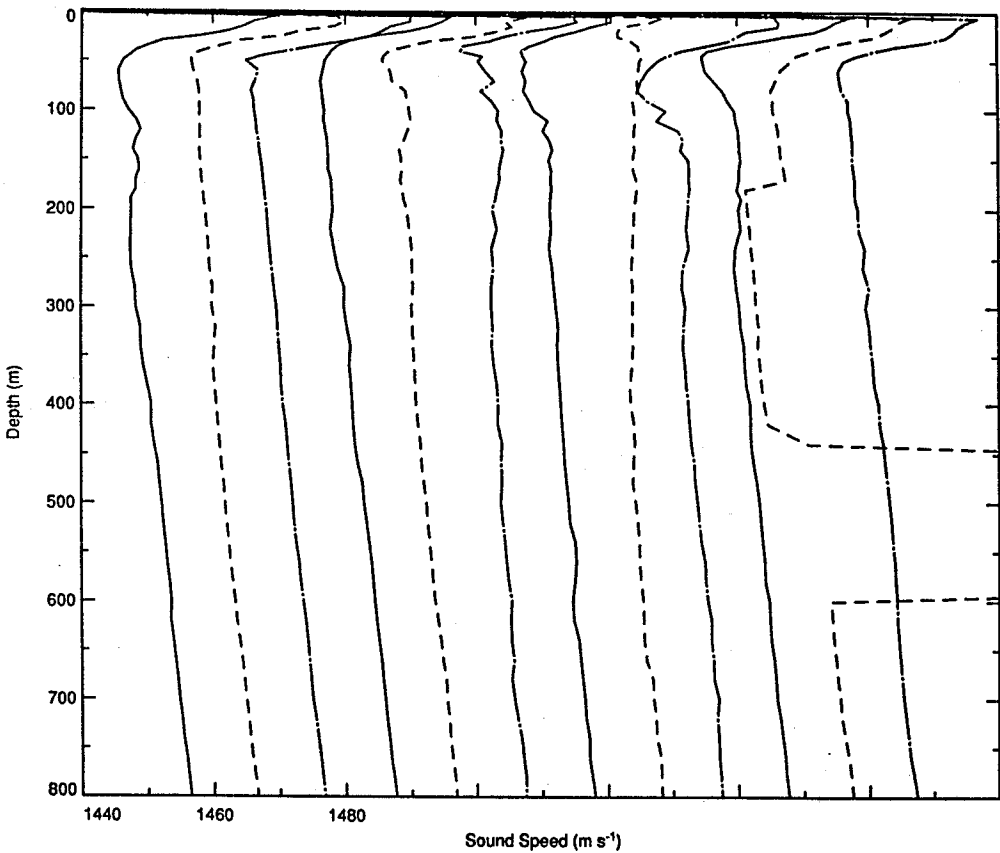
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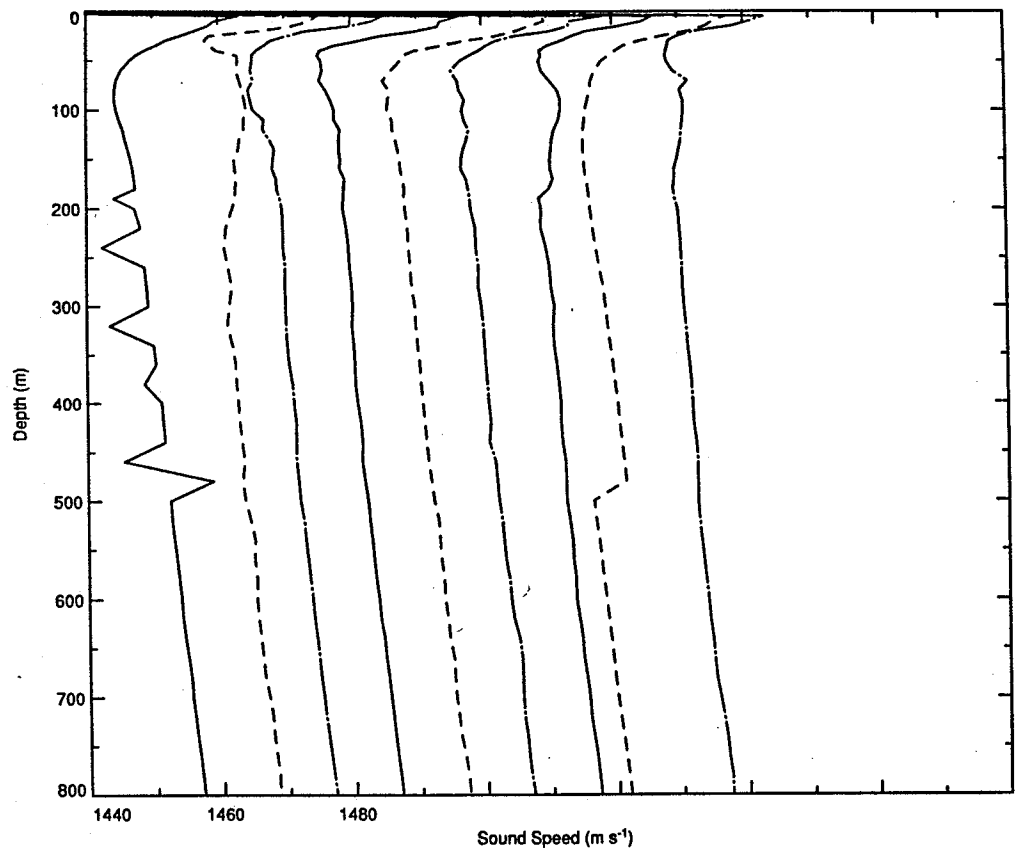


MST89 XSV Drops 1-12



MST89 XSV Drops 13-24





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<p>Profile data from two cruises in the Greenland Sea are presented. During the first cruise in September - October 1988, there were 6 deep CTD stations occupied and 161 shallow CTD, XBT, and XSV drops made. During the second cruise in August - September 1989, there were 6 deep CTD stations occupied and 299 shallow CTD, XBT, and XSV drops made.</p>					
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